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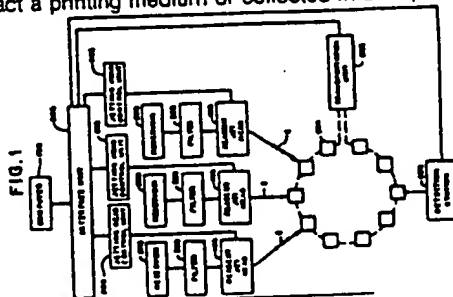
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(54) Apparatus and process for reagent fluid dispensing and printing.

(57) A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube, comprising an orifice at one end and a fluid receiving aperture at the other end, is concentrically mounted within a cylindrical piezo-electric transducer. The fluid receiving aperture is connected to a reservoir containing a selected reagent by means of a filter. The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer and the volume defined by the jetting tube to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer and the volume of the jetting tube to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice. The droplet may be directed to impact a printing medium or collected in a dispensing receptacle.



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APPARATUS AND PROCESS FOR REAGENT FLUID DISPENSING AND PRINTING

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and process for dispensing and printing reagent fluids, wherein a transducer is used to propel small quantities of the fluid towards a positioned target.

Diagnostic assays often require systems for metering, dispensing and printing reagent fluids. In the case of metering and dispensing, such systems comprise both manual and automatic means. For purposes of practicality, the present background discussion will focus on the methods of metering and dispensing 100 micro-liter volumes or less.

The manual systems of metering and dispensing include the glass capillary pipet; the micro-pipet; the precision syringe; and weighing instruments. The glass capillary pipet is formed from a precision bore glass capillary tube. The pipet typically comprises a fire blown bulb and a tubular portion fire drawn to a fine point. Fluid is precisely metered by aspirating liquid through the tube into the bulb to a predetermined level indicated by an etched mark. The fluid may then be dispensed by blowing air through the tube.

The micro-pipet typically comprises a cylinder and a spring loaded piston. The travel of the piston is precisely determined by a threaded stop. The distance the piston travels within the cylinder and the diameter of the cylinder define a precise volume. The fluid is aspirated into and dispensed from the micro-pipet in precise quantities by movement of the piston within the cylinder.

The precision syringe generally comprises a precisely manufactured plunger and cylinder with accurately positioned metering marks. The fluid is introduced into and dispensed from the syringe by movement of the plunger between the marks.

Weighing techniques for dispensing fluids often simply involve weighing a quantity of fluid. The density of the fluid may then be used to determine the fluid volume.

Exemplary automatic metering and dispensing systems include the precision syringe pump; the peristaltic pump; and the high performance liquid chromatography (HPLC) metering valve. The precision syringe pump generally comprises a precision ground piston located within a precision bore cylinder. The piston is moved within the cylinder in precise increments by a stepping motor.

The peristaltic pump comprises an elastomeric tube which is sequentially pinched by a series of rollers. Often the tube is placed inside a semi-circular channel and the rollers mounted on the outer edge of a disc driven by a stepping motor. The movement of the rollers against the tubing produces peristaltic movement of the fluid.

The HPLC metering valve comprises a defined length of precision inner diameter tubing. The fluid is introduced into the defined volume of the tubing with the valve in a first position and then dispensed from the tubing when the valve is placed in a second position.

All of the above metering and dispensing systems have the disadvantage that the volumes dispensed are relatively large. Furthermore, these systems are also relatively slow, inefficient and comprise precision fitted components which are particularly susceptible to wear.

The printing of reagent fluids is frequently required in the manufacture of chemical assay test strips. Selected reagents are printed in a desired configuration on strips of filter paper. The strips may then be used as a disposable diagnostic tool to determine the presence or absence of a variety of chemical components.

Generally, to perform a chemical assay with a test strip, the strip is exposed to a fluid or a series of fluids to be tested, such as blood, serum or urine. In some instances, the strip is rinsed and processed with additional reagents prior to being interpreted. The precise interpretation depends on the type of chemical reactions involved, but it may be as simple as visually inspecting the test strip for a particular color change.

The manufacture of test strips generally involves either a manufacturing process or a blotting process. The blotting process is the simplest manufacturing method and permits most reagents to be applied without modification. A disadvantage of this process is that it is difficult to blot the fluids onto the test strip with precision.

The printing process will often involve any of three well known methods: silk screening; gravure; and transfer printing. The silk screening of reagents generally involves producing a screen by photographic methods in the desired configuration for each reagent to be printed. The screen is exposed under light to a preselected pattern and then developed. The areas of the screen which are not exposed to light, when developed, become porous. However, the areas of the screen which have been exposed to light remain relatively nonporous. The screen is then secured in a frame and the test strip placed below. The desired

reagent fluid, specially prepared to have a high viscosity, is spread over the top side of the screen. The reagent passes through the porous areas of the screen and onto the test strip. The test strip is then subjected to a drying process, specific to each reagent. Once the test strip is dry, it may be printed again using a different screen, pattern and reagent.

5 The gravure method of printing reagents comprises coating a metal surface with a light sensitive polymer. The polymer is exposed to light in the desired predetermined pattern. When developed, the polymer creates hydrophilic and hydrophobic regions. The reagent is specially prepared such that when applied to the metal it will adhere only to the hydrophilic regions. After the specially prepared reagent is applied, the test strip is pressed against the metal and the reagent is transferred from the metal to the test

10 strip.

The transfer printing method comprises transferring the reagents from a die to the test strip in the desired pattern. The die is made with the appropriate pattern on its surface and then coated with the desired, specially prepared reagent. A rubber stamp mechanism is pressed against the die to transfer the reagent in the desired pattern from the die to the rubber stamp. The rubber stamp is then pressed against

15 the test strip to transfer the reagent, in the same pattern, to the test strip.

Each of the above-mentioned reagent printing techniques has significant disadvantages. The most common disadvantage is the requirement that the reagents must be specially prepared. Additionally, if a variety of reagents are to be printed onto a single test strip, the strip must be carefully aligned prior to each printing. This alignment procedure increases the cost and decreases the throughput of the printing process.

20 Moreover, a special die or screen must be produced for each pattern to be printed. A further disadvantage arises in that the above printing methods are unable to place reproducible minute quantities of reagent on the test strip.

It is an object of the present invention to provide a printing and dispensing method and apparatus which avoids these disadvantages.

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SUMMARY OF THE PRESENT INVENTION

The present invention is directed to a reagent dispensing and printing apparatus and method, wherein

30 the apparatus comprises a transducer operative to eject a substantially uniform quantity of reagent in a precise predetermined direction.

According to one preferred embodiment of the present invention used in dispensing reagent fluids, a jetting tube is concentrically located with a piezoelectric transducer. The jetting tube comprises an orifice at one end and a reagent receiving aperture at the other end. The receiving end of the jetting tube is

35 connected to a filter which is in turn connected to a reservoir containing a selected reagent. A jetting control unit supplies an electrical pulse of short duration to the transducer in response to a command issued by a computer. The electrical pulse causes the volume defined by the jetting tube to expand by an amount sufficient to intake a small quantity of reagent fluid from the reservoir. At the end of the pulse duration, the transducer de-expands propelling a small quantity of the reagent fluid through the orifice and into a fluid

40 receptacle. If desired, additional droplets may be deposited in the receptacle or the receptacle aligned with an additional jetting tube for receiving an additional reagent fluid.

An additional preferred embodiment of the present invention may be used for printing reagent fluids onto a print medium. In this embodiment, the jetting tube is aligned with the printing medium such that the propelled droplet impacts a precise position on the medium. The jetting tube or print medium may then be

45 repositioned and another droplet expelled from the jetting tube. The process may be repeated until a desired configuration of the reagent fluid is printed on the medium.

One advantage of the present invention is that precise minute quantities of reagent fluid may be dispensed or printed in a reproducible manner. Additionally, the method and apparatus may be used to emit droplets of fluids having a wide range of reagent fluid viscosities and surface tensions. The reagents

50 do not in general have to be specially adapted for use with the present invention.

The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic representation of a first preferred embodiment of the present invention showing the use of multiple jetting heads to meter and dispense reagent fluid.

FIGURE 2a is a perspective view of a first preferred embodiment of the jetting head of the present invention.

FIGURE 2b is a cut-away perspective view of the preferred embodiment of Fig. 2a taken along lines 2b-2b with the contact pins removed.

FIGURE 2c is a sectional representation of the preferred embodiment of Fig. 2a taken along lines 2c-2c.

FIGURE 2d is a sectional representation of the preferred embodiment of Fig. 2c taken along lines 2d-2d.

FIGURE 2e is a sectional representation of the jetting tube and transducer of the preferred embodiment of Fig. 2b taken along lines 2e-2e.

FIGURE 3 is a schematic representation of a second preferred embodiment operating in the drop on demand mode as a reagent printing system.

FIGURE 4 is a schematic representation of a third preferred embodiment operating in the continuous mode as a reagent printing system.

FIGURE 5a is a schematic representation of a portion of the jetting head control unit showing the LED strobe circuit.

FIGURE 5b is a schematic representation of a portion of the jetting head control unit showing the high voltage power supply circuit.

FIGURE 5c is a schematic representation of a portion of the jetting head control unit showing the print control circuit.

FIGURE 5d is a schematic representation of a portion of the jetting head control unit showing a portion of the print pulse generator.

FIGURE 5e is a schematic representation of a portion of the jetting head control unit showing an additional portion of the pulse generator.

FIGURE 6a is a perspective view of a second preferred embodiment of the jetting head of the present invention.

FIGURE 6b is an exploded view of the preferred embodiment of Fig. 6a.

FIGURE 7 is a sectional representation of a third preferred embodiment of the jetting head of the present invention.

FIGURE 8 is a sectional view of a symmetrical portion of a fourth preferred embodiment of the jetting head of the present invention.

FIGURE 9 is a graph of the drop mass of the emitted droplets as a function of emission frequency for several fluid viscosities.

FIGURE 10 is a graph of the velocity of the emitted droplets as a function of frequency for several fluid viscosities.

FIGURE 11 is a graph of the total weight of fluid emitted as a function of the number of emitted droplets for a given fluid.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Turning now to the drawings, Fig. 1 shows a schematic representation of a first preferred embodiment of a reagent dispensing system generally represented as reference numeral 30. The dispensing system 30 comprises a plurality of reagent fluid reservoirs 200, a plurality of filters 300, a plurality of reagent jetting heads 400, a plurality of jetting head control units 500, an interface unit 600, a computer 700, transportation unit 902, a plurality of fluid mixing cells 904 and a detection station 906.

The reservoir 200 holds a selected quantity of reagent fluid for dispensing. The reservoir 200 is maintained at atmospheric pressure by suitable means such as an atmospheric vent. The reagent fluid is transferred from the reservoir 200 through the filter 300 to the reagent jetting head 400. The filter 300 is placed between the reservoir 200 and the jetting head 400 to ensure that any particular foreign matter in the reagent fluid is trapped before entering the jetting head 400.

The plurality of jetting heads 400 and the detection station 906 define a processing path. Each jetting head 400, which is described in detail below, ejects uniformly sized droplets of reagent fluid. The droplets are propelled, with controlled velocity and direction, towards a selected mixing cell 904 positioned along

the processing path by the transportation unit 902. The mixing cells 904 are comprised of non-reactive material and function as minute holding tanks for the dispensed reagent fluid.

The plurality of jetting heads 400, shown in Fig. 1, are positioned sequentially along the processing path. Alternately, some or all of the plurality of jetting heads 400 may be positioned with respect to the transportation unit 902 such that the heads 400 direct the droplets 2 into a selected mixing cell 902 simultaneously.

The jetting heads 400 and the transportation unit 902 are controlled by the computer 700. The computer 700 issues commands to an interface unit 600 which is electrically connected to the transportation unit 902 and to the jetting head control unit 500. The interface unit 600 is of conventional design and is used to control the transfer of information between the computer 700 and the jetting control unit 500. The interface unit 600 is also used to control the transfer of information between the computer 700 and the transportation unit 902.

A first embodiment of the reagent jetting head is shown in Figs. 2a - 2e and generally represented by numeral 400. The jetting head 400 comprises a two piece symmetrical housing 402, 404. The housing 402, 404, when assembled, is adapted to form an orifice aperture 406, an air vent and reagent supply channel 410 and a transducer chamber 403, shown in Fig. 4b. Four screws 408, adapted to respective housing screw apertures 416, hold the housing 402, 404 in an assembled configuration.

The jetting head 400 further comprises a jetting tube 432, a piezo-electric transducer 434 and a reagent fluid supply tube 430. The jetting tube 432 defines a tapered orifice 433 at one end and a fluid receiving aperture 431 at the other end for expelling and receiving fluid, respectively. The piezo-electric transducer 434 is cylindrically shaped and secured concentrically about the mid-region of the jetting tube 432 with epoxy or other suitable means.

The piezo-electric transducer 434, shown in Fig. 2e, defines a first and second end and comprises a section of cylindrically shaped piezo-electric material 435. An inner nickel electrode 437 covers the inner surface of the cylinder 435. The electrode 437 wraps around the first end of the cylinder 435 a sufficient distance to enable electrical connection external to the cylinder 435.

A second nickel electrode 436 covers the majority of the outer surface of the cylinder 435. The second electrode is electrically isolated from the first electrode 437 by an air gap at the face of the second end of the cylinder 435 and by an air gap on the outer surface of the cylinder 435 near the first end. When an electrical pulse is applied to the first and second electrodes 437, 436 a voltage potential is developed radially across the transducer material 435. The voltage potential causes the radial dimensions of the transducer 435 to change, which causes the volume defined by the transducer 434 to also change.

The jetting tube 432 is positioned in the transducer chamber 403 such that the receiving end 431 extends beyond the rearward end of the transducer 434. The receiving end 431 of the jetting tube 432 is inserted into one end of a reagent supply tube 430. The supply tube 430 is sealingly held to the jetting tube 432 by concentric teeth 412 formed by the housing sections 402, 404. The teeth 412 not only seal the supply tube 430 to the jetting tube 432, but, also, seal the supply tube 430 to the housing 402, 404.

The second end of the supply tube 430 passes through the channel 410 and into a reagent reservoir 200. The reservoir 200 contains the reagent fluid to be dispensed by the jetting head 400. As the reagent fluid is dispensed, air is supplied to the reservoir 200 through the channel 410 to prevent the creation of a vacuum in the reservoir 200. The reservoir 200 is releasably attached to the housing 402, 404 and held in place by frictional forces. A reservoir cap 202 is flexibly attached to the reservoir 200 and adapted such that the cap 202 may be used to secure the opening in the reservoir 200 when the reservoir 200 is disengaged from the housing 402, 404.

The position of the jetting tube 432 defines the horizontal plane of the jetting head 400. The jetting tube 432 and the transducer 434 are held in a pre-defined vertical relationship with respect to the housing 402, 404 by means of two upper vertical alignment pins 418 and two lower vertical alignment pins 418. The two upper vertical alignment pins 418 extend horizontally from the housing section 402 into the transducer chamber 403. Similarly, the two lower vertical alignment pins 418 extend horizontally from the housing section 404 into the transducer chamber 403. Each vertical alignment pin 418 is formed integrally with the respective housing sections 402, 404.

The jetting tube 432 and the transducer 434 are held in a predefined horizontal relationship with respect to the housing 402, 404 by means of four horizontal alignment pins 424. Two of the horizontal alignment pins 424 extend horizontally from the housing section 402 approximately midway into the transducer chamber 403. Similarly, two of the horizontal alignment pins 424 extend horizontally from the housing section 404 approximately midway into the transducing chamber 403. Each horizontal alignment pin 424 is formed integrally with the respective housing section 402, 404. The alignment pins 418, 424, sealing teeth 412 and orifice aperture 406 are aligned and adapted to hold the jetting tube 432 and transducer 434 such

that the orifice 433 of the jetting tube 432 extends into the orifice aperture 406.

An electrical transducer activation pulse is supplied to the piezo-electric transducer 434 from the jetting head control unit 500 by means of two contact pins 422. A quantity of fluid will be dispensed from the jetting tube for each applied activation pulse. The activation pulse can be produced by a variety of conventional circuits or commercially available units. Therefore a detailed description of such a circuit will not be provided. However, a circuit for producing a series of activation pulses is provided in the description of the printing embodiment below. Due to the differing constraints involved in dispensing and printing, the circuit in the printing embodiment is not required to produce only a single pulse. However, one skilled in the art could, if desired, modify the circuit to produce a single pulse on demand for use in the dispensing embodiment.

Each contact pin 422 defines an enlarged head 423 which is adapted to contact the respective first and second electrodes 437, 436 located on the outer surface of the transducer 434. Two contact pin holders 414, integral with the housing 402, 404, are positioned to hold the respective contact pins 422 under the pin heads 423 such that each pin head 423 electrically engages the appropriate electrode 437, 436 of the transducer 434. Two contact pin engaging posts 420 extend from the housing 402, 404 opposite the contact pin holders 414 to engage and hold the contact pins 422 against the contact pin holders 414. The ends of the contact pins 422 opposite the pin heads 423 extend through the housing 402, 404 by means of contact pin apertures 421. Since the housing sections 402, 404 are formed symmetrically to one another, the contact pins 422 may be optionally attached above the transducer 434.

In operation, the reservoir 200 containing reagent fluid is fastened to the jetting head 400 such that the fluid supply tube 430 extends into the reagent fluid. The filter 300 may be fitted to the free end of the supply tube 430 or positioned inside the reservoir 200. Air is supplied through the channel 410 around the supply tube 430 to prevent the reservoir 200 from falling below atmospheric pressure. The air is prevented from entering around the supply tube 430 and into the transducer chamber 403 by the seal created between the sealing teeth 412 and the supply tube 430. The jetting tube 432 may be primed by slightly pressurizing the reservoir 200 to cause the reagent fluid to travel through the supply tube 430 and into the jetting tube 432. Once primed, the fluid is prevented from substantially withdrawing from the jetting tube 432 by the surface tension of the reagent fluid at the orifice 433.

The transducer activation pulse is conducted to the contact pins 422 of the jetting head 400. The contact pins 422 communicate the high voltage pulse to the electrodes 437, 436 of the transducer 434 with polarity such that the concentrically mounted transducer 434 expands. The rate of expansion is controlled by the rise time of the high voltage pulse which is preset to generate a rapid expansion. The expansion of the transducer 434 causes the jetting tube 432, which is epoxied to the transducer 434, to also expand. The expansion of the tube 432 generates an acoustic expansion wave interior to the tube 432 which travels axially towards the orifice 433 and towards the fluid receiving aperture 431. When the expansion wave reaches the orifice 433, the reagent fluid is partially drawn inwardly. However, the surface tension of the fluid acts to inhibit substantial inward fluid movement.

When the expansion wave reaches the end 431 of the tube 432, the expansion wave is reflected and becomes a compression wave which travels towards the center of the piezo-electric tube 434. The high voltage pulse width is adapted such that when the reflected compression wave is beneath the piezo-electric tube 434, the high voltage pulse falls, resulting in a de-expansion of the transducer 434 and the jetting tube 432. This action adds to the existing acoustic compression wave in the interior of the jetting tube 432. The enhanced compression wave travels toward the orifice 433 causing reagent fluid to be dispensed from the tube 432. The fluid is propelled from the orifice 433 as a small droplet 2 and deposited in the selected mixing cell 904 positioned by the transportation unit 902. One droplet 2 is dispensed for each transducer activation pulse. This mode of dispensing is referred to as the drop on demand mode.

In some instances, the droplet 2 may be accompanied by at least one smaller satellite droplet. However, even if satellite droplets are present, the volume and velocity of the reagent droplets 2 are highly reproduceable. This reproduceability allows for precise dispensing of uniform, controllably sized droplets 2 of reagent fluid into the mixing cell 904.

The droplets 2 of reagents impact the mixing cell 904 with sufficient force and volume to cause fluidic mixing of the reagents. Once the desired amounts of the selected reagents are deposited in the selected mixing cell 904, mixing cell 904 is transported to the detection station 906 where the mixed reagents may be extracted for use or analyzed for assay results.

The dispensing system 30 provides numerous advantages based upon the ability of the reagent jetting head 400 to rapidly and reproduceably eject uniform quantities of a wide range of reagents. The reaction times of some chemical processes are dependent upon the volume of the reagents used. The ability of the dispensing system 30 to dispense such minute amounts of reagents thereby reduces the processing time

of certain chemical assays. Furthermore, some chemical assays require a wide range of dilution ratios. Many conventional dispensing systems are unable to dispense the reagents in volume small enough to make the desired assay practical. The dispensing system of the present invention overcomes this disadvantage.

5 In addition to dispensing reagent fluids, certain embodiments may be used for precision printing of reagents onto a printing medium such as filter paper to produce an assay test strip. A printing system 10 using the present invention is represented in Fig. 3. Structure similar in form and function to structure described above will be designated by like reference numerals. The printing system 10 comprises a reagent fluid reservoir 200, a filter 300, a reagent jetting head 400, a jetting head control unit 500, an interface 600, a computer 700, and an x-y plotter 800.

10 The x-y plotter 800 is a commercially available pen plotter, mechanically modified in a conventional manner such that the pen is replaced with the jetting head 400. The general operation and structure of the plotter 800 will not be described in detail. The plotter 800 accepts commands from the computer 700 thru a standard RS-232 serial interface contained within the interface unit 600. The plotter 800 processes the commands and produces control signals to drive an x-axis motor (not shown) and a y-axis motor (not shown). The x-axis motor is used to position the jetting head 400 and the y-axis motor is used to position a drum (not shown) to which the printing target 1 is attached.

The plotter 800 produces a pen down signal PENDN. This signal is applied to the control unit 500 and indicates that the plotter 800 is ready to begin a printing operation.

20 The control unit 500 also receives control signals from the interface unit 600. These signals include signals HIGHER*, LOWER* to control the magnitude of the pulse applied to the transducer 434; a reset signal RST to reset the control unit 500; and a series of print signals PRT*. The generation of these signals will not be described in detail since their production is performed by the conventional interface unit 600.

25 The jetting head 400 and fluid supply system 200, 300 are initialized and operate substantially as described above. The jetting head control unit 500, shown in Figs. 5a - 5e comprises a print control circuit 510, a pulse generator 530, a high voltage supply 540, and a strobe pulse generator 560. The control unit 500 also comprises a power supply. However, since the power supply is of conventional design it will not be shown or described in detail.

30 The print control circuit 510 receives the pen down signal PENDN from the plotter 800 and comprises a transistor Q100, a one-shot circuit U100, two NAND-gates U101, U102, a line decoder multiplexer U107 and four inverters U103-U106. The pen down signal PENDN is applied to the base of the transistor Q100 by resistors R100, R101 and diode D100. The emitter of transistor Q100 is tied to ground and the collector is connected to the +5 volt supply by resistor R102.

35 The one-shot U100 comprises inputs A, B and an output Q. The B input of the one-shot U100 is connected to the collector of the transistor Q100 and the A input is tied to ground. The time period of the pulse produced by the one-shot U100 is determined by a resistor R104, a variable resistor R105 and a capacitor C100. The output Q of the one-shot U100 is combined with the collector output of the transistor Q100 by the NAND-gate U101 and then inverted by the NAND-gate U102. The circuit is operative to produce an adjustable delay in the application of the pen down signal PENDN to the control unit 500.

40 The line decoder U107 is circuited to function as a 3 input AND-gate. The output of the NAND-gate U102 is applied to the first input of the decoder U107; the print signal line PRT* comprising a series of pulses from the interface unit 600 is applied to the second input; and a jetting head ON/OFF signal from switch S1 is applied to the third input. The inverter U106 inverts the output of the line decoder U107 to generate the print control signal PRT* and the inverters U103-U105 invert the control signals LOWER*, HIGHER*, and RST signals, respectively.

45 The high voltage supply 540, shown in Fig. 5b, provides +175 volts DC to produce a maximum pulse of +150 volts peak to peak at the reagent jetting head 400. The high voltage supply 540 comprises differential amplifier U12 and transistors Q1, Q2, Q13, Q14. A stable reference voltage of -2.5 volts DC is produced at the junction of a resistor R13, connected to the -15 volt supply, and a diode CR6, connected to ground. The reference voltage is combined with a resistor R14 to produce an adjustable, stable voltage reference for the amplifier U12. The reference voltage is applied to the inverting input of the amplifier U12 through a resistor R11. The noninverting input of the amplifier U12 is connected to ground by a resistor R12. The amplifier U12, in combination with a feedback resistor R10, produces an output signal proportional to the difference of the voltage reference signal and the ground potential.

55 The output of the amplifier U12 is applied to the base of the transistor Q2 whose collector is connected to the +15 volt supply. The signal produced at the emitter of the transistor Q2 is applied to the base of the transistor Q1 through resistors R8, R6, R5, a transformer L1 and diodes CR4, CR2, CR1. The emitter of the transistor Q1 is connected to ground and the collector is connected to the +15 voltage supply through the

transformer L1. A diode CR3 connects the collector of the transistor Q1 to the junction of the resistor R5 and the diode CR4. The transistor Q1 is biased for proper operation by resistors R7, R6, R5. The resistor R7 and a capacitor C22 connect the junction of the resistor R8, R6 to the +15 voltage supply.

The transistor Q1 and the transformer L1 form a "flyback" blocking oscillator. Any increase in current supplied by the transistor Q1 produces an increase in energy transferred through the secondary winding of the transformer L1 and diode CR5. Therefore, an increase in current supplied by the transistor Q1 results in an increase in power available to the high voltage output. The diodes CR1-CR4 form a "Baker clamp" which prevents transistor Q1 from saturating. The clamp thereby avoids transistor storage time.

The diode CR5 is connected to a multiple pi filter formed by the inductors L3, L2, capacitors C24, C21, C41 and resistors R29. The multiple pi filter attenuates ripple and switching spikes in the signal supplied to the transistor Q13 which produces the high voltage output V_{++} . A resistor R64 connects the base of the transistor Q13 to the emitter and to the resistor U29. The base is also connected to the collector of the transistor Q14 by a resistor R65. The base of the transistor Q14 is connected to the +15 volt supply by a resistor R67 and to ground by a resistor R66. The emitter of the transistor Q13 provides a signal HV SENSE which is fed back to the inverting input of the amplifier U12 through a resistor R9. The high voltage output V_{++} is produced at the collector of the transistor Q13. The proper biasing of the transistor Q13 is provided by resistor R64 and the biasing circuit comprising the transistor Q14, resistors R67, R66, R65.

The pulse generator 530, shown in Figs. 5d, 5e, comprises an opto-isolator U18, a one-shot U23, a digital to analog (D/A) converter U30 and two binary counters U24, U25. The pulse generator 530 accepts control signals PRT*, LOWER*, HIGHER*, RST and produces the activation pulse which is applied to the transducer 434. In normal operation, the PRT* control signal is supplied to the opto-isolator U18 by a jumper JMP between contact points E5, E6. The opto-isolator U18 is of conventional design and comprises a light emitting diode (LED) circuit and a photo-element circuit. A resistor R15 operates as the load resistor for the LED circuit of the isolator and a capacitor C25 suppresses transient noise on the voltage supply to the isolator U18. The output of the isolator U18 is applied to one input of the one-shot U23 whose time constant is adjustably determined by resistors R38, R25 and a capacitor C30. The pulse from the non-inverting output of the one-shot U23 is fed to the base of a transistor Q9. A resistor R39 sets the approximate base current of the transistor Q9 which is used as a level shifter for converting the CMOS signal level to the +15 volt DC signal level.

The control of the rise and fall rates of the pulse generator 530 is accomplished by directing a pair of current source transistors Q11, Q12 to charge and discharge a capacitor C57. The transistor Q11 is operative as a source of current and the transistor Q12 is operative as a sink for current. A transistor Q10 controls the level of the current by applying an appropriate bias current through a resistor R56 to the base of the transistor Q11. The biasing of the transistors Q11, Q12 is critical to the proper rise and fall rates. Therefore precision voltage references CR13, CR15 are used to provide respective bias reference voltages. A temperature compensation network is formed from zener diodes CR14, CR16 and resistors R55, R54 to maintain stable operation of the transistors Q11, Q12, respectively. The variable resistors R49, R52 may be used to adjust the fall time and rise time, respectively, of the output pulse applied to the reagent jetting head 400. A plurality of resistors R45, R46, R47, R48, R49, R51, R52, R53, R56, R57, R58 are used to properly bias the transistor Q10, Q11, Q12 and capacitors C55, C60 are circuited to maintain stability of the circuit.

The impedance of the output stage of the rise and fall circuitry Q10, Q11, Q12 is very high. With such a high impedance, circuit elements attached to the capacitor C57 could affect the linearity of the rise and fall time constants. Therefore, an FET input operational amplifier U32 is used as an impedance interface. The amplifier U32 is configured in the noninverting mode and circuited with capacitors C58, C59 for stability.

The output of the amplifier U32 is applied to an inverting amplifier U31 by means of a resistor R62. The amplifier U31 inverts and conditions the pulse control signal with the aid of resistors R59, R60. Resistors R61, R63, connected to the -15 voltage supply, provide a means for adjusting the DC level offset of the amplifier U31 output signal. Capacitors C51, C52 are connected to enhance the performance and stability of the circuit.

The output of the amplifier U31 is applied by means of a resistor R41 to the positive voltage reference signal input REF(+) of the D/A converter U30. The negative voltage reference signal input REF(-) is tied to ground by a resistor R40. The D/A converter U30 produces output signals IOUT, IOUT* which are proportional to the difference between the positive and negative voltage reference signal inputs REF(+), REF(-). Capacitors C48, C49, C50 are connected to the D/A converter U30 to enhance stability.

The D/A converter outputs IOUT, IOUT* are also proportional to an 8-bit binary value applied to inputs B1-B8. The binary value is supplied by the counters U24, U25 which are controlled by the function signals LOWER*, HIGHER* and RST. The LOWER* signal and the HIGHER* signals are applied to the count up and

count down inputs CU, CD of the counter U24 by means of opto-isolators U19, U20. The carry and borrow outputs CY, BR of the counter U24 are connected with the count up and count down inputs CU, CD of the counter U25. The reset inputs RST of both counters U24, U25 receive the RST signal by means of an opto-isolator U21. Resistors R16, R17, R18 are used as load resistors for the LED circuits of the isolators U19, U20, U21 and capacitors C26, C27, C28 are used to enhance the stability of the isolator circuits.

The counters U24, U25 may optionally be preloaded to the selected 8-bit binary value through input lines TP0-TP7. The input lines TP0-TP7 are normally biased to the logical high signal state by resistive network U22. The selected binary value is loaded into the counters U24, U25 by pulling the respective inputs TP0-TP7 low and applying an external, active low, load signal EXT LOAD to pin TP8. The load signal pin TP8 is connected to the load inputs LOAD of the counters U24, U25 and conditioned by a clipping circuit comprised of diodes CR9, CR10 and a pull-up resistor of the resistor network U22.

The noninverted and the inverted outputs IOUT, IOUT⁻ are connected to the inverting and noninverting inputs of a differential amplifier U29. The output of the amplifier U29 is fed back to the inverting input by a resistor R50. The amplifier U29 converts the current output of the D/A converter U30 to a voltage output. Capacitors C56, C47 are provided to enhance circuit stability.

The output of the amplifier U29 is applied to the noninverting input of the amplifier U28. The output of the amplifier U28 is fed back to the inverting input by means of a capacitor C46 and a resistor R37. The inverting input is also connected to ground by a resistor R36. To enhance the frequency response of the amplifier U28, a resistor R43 and a capacitor C54 are connected between the frequency compensation input FC and ground. An adjustable DC offset is provided by connecting the output offset inputs OF, OF with a variable resistor R42. The wiper of the resistor R42 is connected to the high voltage power supply output V⁺.

The output of the amplifier U28 is also connected to the base of a transistor Q4 and through diodes CR11, CR12 to the base of a transistor Q7. The transistor Q4, Q7, Q3 and resistors R30-R35 form an output circuit capable of driving high capacitive loads at high slew rates and wide bandwidth. The variable resistor R31 may be used to set the maximum current through the bias network R30, R33 by measuring the voltage drop across resistor R35.

The strobe generator 560 produces a strobe pulse and comprises transistors Q101-Q105 and a one-shot circuit U108. The strobe intensity is determined by the circuit comprising the transistors Q101-Q104 and resistors R109-R115. The circuit is connected to the anode of the LED 900 and receives two inputs from the interface unit 600 to produce four levels of light intensity in the LED 900.

The activation and duration of activation of the LED 900 is determined by the one-shot U108 and the transistor Q105. The one-shot U108 comprises inputs A, B and an output Q. The strobe signal STROBE is applied to the B input from the interface unit 600. The duration of the one-shot U108 output pulse is controlled by the adjustable RC network R107, R108. The output Q is applied to the base of the transistor Q105 by resistor R108. The collector of the transistor Q105 is connected to the cathode of the LED 900 to draw current through the LED 900.

The computer 700, control unit 500 and plotter 800 must be initialized. The initialization of the computer 700 and the plotter 800 will not be discussed since these units are of conventional design and operation.

To initialize the jetting head control unit 500, the computer 700 directs the interface unit 600 to issue a reset command. The reset signal RST is conducted to the control unit 500 whereupon the counters U24, U25 are cleared. The computer 700 then retrieves from its memory, or by conventional operator input, the desired digital setting for the D/A converter. This setting may also be calculated from data and may be tailored to specific sizes of jetting heads 400 or reagent fluids. The computer 700 then issues a series of commands, through the interface unit 600, to increment or decrement the counters U24, U25 to correspond to the desired binary setting. If the command directs that the counters are to be raised, then the HIGHER signal is applied through the opto-isolator U20 to the count up CU input of the counter U24. Similarly, if the command directs that the counters are to be lowered then the LOWER signal is applied through the opto-isolator U19 to the count down CD input of the counter U24. Since the carry and borrow outputs CY, BR of the counter U24 are connected to the count up and count down inputs CU, CD, respectively, of the counter U25, the digital setting applied to the D/A converter U30 may range from 0 to 255. Alternately, the counters U24, U25 could be initialized to a desired setting by loading the binary value on the lines TP0-TP7 and strobing the EXT LOAD line.

Once the control unit 500 and the plotter 800 are initialized, the printing cycle may begin. The computer 700 issues a command to the interface unit 600 to produce the series of PRT signal pulses. The computer 700 then commands the plotter 800 to print, for example, a line along a selected path. The plotter 800 positions the jetting head 400 and target 1 and issues the pen down signal PENDN. The signal is delayed by the print control circuit 510 to ensure that the target 1 is properly positioned. At the expiration of the

delay, the signal is ANDed with the closed enable switch S1 and the series of print pulses PRT*. The result of the AND operation is the application of the PRT* pulses to the pulse generator circuit 530.

The PRT* signal is applied through the jumper JMP to the opto-isolator U18 and then to the one-shot U23. The one-shot U23 produces a pulse signal which is then converted from CMOS signal levels to the 15 volt DC signal level by the transistor Q9. The rise and fall circuitry comprising Q10, Q11, Q12 converts the square wave pulse into a pulse having the rise and fall characteristics preset by the resistors R49, R52. The conditioned pulse is then amplified by the amplifier U32 and applied to the amplifier U31.

The amplifier U31 converts the polarity of the conditioned pulse to that acceptable by the D/A converter U30 and supplies an adjustable DC offset. The DC offset is used to counteract possible distortion attributable to the amplifier U31. The distortion arises in that, for the amplifier U31 to be adequately responsive, a small degree of current must flow through the resistor R41. This current creates an offset condition at the output of the amplifier U29 which is then scaled by the D/A converter U30 in correspondence with the binary data. The resistor R63 allows a small amount of current to be applied to the amplifier U31 to control the offset voltage attributable to the current flowing through the resistor R41.

The D/A converter U30 scales the difference between the inputs REF(+), REF(-) using the binary data supplied to input lines B1-B8 to produce a current output pulse IOUT and a current inverted output pulse IOUT*. The two outputs IOUT, IOUT* are fed to the amplifier U29 which convert the current outputs into a single voltage output. The scaled, conditioned pulse is then applied to the output circuit comprising the amplifier U23 and the transistors Q3, Q4, Q5, Q6, Q7. The circuit produces a high voltage pulse with the aforementioned rise and fall characteristics to drive the piezo-electric transducer 434.

The high voltage pulse is applied to the transducer 434 and causes a droplet 2 of fluid to be propelled onto the target 1. Since the pen down signal PENDN is still applied, additional droplets 2 are produced from the jetting head 400. The plotter 800 moves the jetting head 400 and target 1 along the desired path during the emission of the droplets 2 to produce the desired printed line. When the printing is complete, the plotter 800 removes the pen down signal PENDN and the droplet emission stops. Of course it should be understood that dots, circles and the like could be produced by appropriate positioning of the target 1 and jetting head 400.

The size and uniformity of the droplets 2, as well as the presence of any satellite droplets, may be observed with the aid of the scope 950 and the LED 900. The scope 950 and the LED 900 are positioned such that the droplets 2 pass between the scope 950 and the LED 900 and within the focal range of the scope 950. The strobe pulse when applied to the LED 900 causes the LED 900 to momentarily flash. The timing of the activation and the width of the pulse may be adjusted such that the flash occurs when the fluid, expelled in response to the high voltage pulse, is between the scope 950 and the LED 900. The dispensed quantity of fluid may then be observed in flight or at or near the moment of separation from the orifice 433. Corrections based on the observation may then be made to the system 10.

Since each droplet 2 is small in volume, the droplet 2 may be rapidly absorbed by the target 1, thereby allowing rapid and precise placement of a variety of reagents on the target 1 with reduced drying time and reduced potential of fluidity mixing. In addition, the ability to place small droplets 2 in a precise manner enables the target 1 to be printed in a high density matrix with a variety of reagents as isolated matrix elements.

In some printing applications, particularly when printing fluids of flow viscosity and surface tension, it may be desirable to force the fluid through the jetting tube 432 under pressure and allow the vibrations produced by the transducer 434 to break the emitted fluid stream into precise droplets 2. Under this mode of printing, the emission of droplets 2 can not be stopped by cessation of the transducers activation pulse. It is therefore necessary to prevent fluid emission by other means. One preferred means of momentarily stopping emission of the droplets is shown schematically in Fig. 4. In this arrangement, structure similar to structure represented in Fig. 3 in form and function, is represented by like reference numerals.

The arrangement, generally represented by the numeral 20, includes a closed reagent recirculation system comprising a normally closed three way valve 970, a sump 960 and a recirculation pump 980. In the continuous mode, the reagent fluid is forced out the orifice 433 by hydraulic pressure and broken into a series of substantially uniform droplets 2 by movement of the transducer 434. A regulated, filtered air supply 100 is used to pressurize the reagent fluid reservoir 200. The reagent fluid within the reservoir 200 may optionally be agitated by a magnetic stirrer unit 990. This is especially useful for reagent fluids comprising suspended particles.

The three-way valve 970 comprises a common channel, a normally open channel and a normally closed channel. The fluid is forced through the filter 300 and applied to the normally closed channel of the valve 970. When the normally closed channel is closed, the normally open channel of the valve 970 functions as a vent for the reagent jetting head 400. The common channel is connected to the reagent supply tube 430

of the jetting head 400. The reagent supply tube 430 is also connected to the sump 960.

In operation, the normally closed channel is opened by an appropriate signal supplied by the computer 700 which also closes the normally open channel. When the normally closed channel is opened, fluid is permitted to pass to the sump 960 and to the jetting head 400. The sump 960 collects the reagent fluid not transferred to the jetting head 400. The sump 960 supplies the collected fluid to the inlet side of the recirculating pump 980 which returns the fluid to the reservoir 200. The returned fluid is then mixed with the contents of the reservoir 200 and is available for recirculation.

When operating in the continuous mode, rather than interrupt the continuous stream of print pulses to the jetting head 400, the printing may be momentarily stopped by closing the normally closed channel of the valve 970. The closing of the normally closed channel stops the flow of reagent fluid to the jetting head 400 and allows the jetting head 400 to vent to atmospheric pressure. With the fluid supply blocked, the transducer 434 is unable to expel further droplets 2. Thus, if positioning of the target 1 by the plotter 800 requires a longer time interval than the time between droplet 2 emission, the computer 700 may close the normally closed channel of the valve 970. The plotter 800 may then position the target 1 or position a new target 1 as desired.

When printing, the active ingredient of the reagent is tailored to achieve a desired concentration per unit area on the target 1. However, to a certain extent the final concentration per unit area can be adjusted by varying the density of the droplets 2 printed on the target 1. The preferred embodiment is particularly well suited to this application due to its ability to print precise, discrete pels of reagent.

A second preferred embodiment of the jetting head is illustrated in Figs. 6a-6b and is generally represented as 400'. The jetting head 400' comprises housing formed into three sections 401', 402', 403'. The housing section 403' comprises a recessed region which forms the reagent fluid reservoir 200' when the housing section 403' is positioned against housing section 402'.

The jetting head 400' further comprises a piezo-electric transducer 434' and a reagent jetting tube 432' similar to those of the first embodiment. The jetting head 400' and the transducer 434' are most clearly shown in Fig. 6b. The jetting tube 432' defines an orifice 433' at one end and a reagent fluid receiving aperture 431' at the other end. The transducer 434' is mounted to the jetting tube 432' concentrically about the mid-region of the tube 432' with epoxy.

The transducer 434' and the jetting tube 432' are positioned in channels 420', 418', 416' located in the housing sections 402', 401'. The channel 416' comprises a plurality of sealing teeth 412' operative to engage and seal against the fluid receiving end 431' of the jetting tube 432'. The channel 416' is connected to the reagent fluid supply channel 430'. The supply channel 430' is connected with the fluid reservoir 200' by means of an aperture 431' through the housing section 402', shown in Fig. 6b.

The reservoir 200' comprises a flexible reservoir lining 201' adapted to contain the reagent fluid. The lining 201' comprises one aperture which is connected to the housing 402' to allow the fluid to pass from the lining 201'. A vent (not shown), located in the housing 403', allows the space between the reservoir 200' and the lining 201' to be vented or pressurized. A filter 300' is positioned within the aperture 202' to trap unwanted particulate foreign matter.

Electrical pulses are supplied to the transducer 434' by means of two contact pins 422'. The pins 422' are inserted through respective apertures 419' of the housing section 402' and respective apertures 421' of the housing section 403'. Two thin electrically conductive strips 410', 411', shown in Fig. 6b, are used to connect the transducer 434' with the contact pins 422'. A protective shield 405' extends from the housing section 403' to partially isolate the protruding portions of the contact pins 422'.

The function and operation of the jetting head 400' is similar to that of the jetting head 400 and therefore will not be discussed in detail. The collapsible inner lining 201' of the reservoir 200 allows the jetting tube 432' to be primed by pressurizing the reservoir 200' through the vent 205'. Once primed, the jetting head 400' may be used as described above in reference to the jetting head 400.

The jetting head 400' provides an advantage in that the entire fluidic system is contained in one housing. Such containment allows for fast and efficient replacement of the jetting heads without fluid contamination problems.

A third preferred embodiment of the jetting head is shown in Fig. 7 and generally represented as 400". The jetting head 400" comprises a housing 403", a reagent fluid supply tube 406", a piezo-electric transducer 434" and an orifice plate 404". The housing 403" defines a conically shaped fluid chamber 432". An orifice plate 404", defining an orifice 433", is fastened to the housing 403" such that the orifice 433" is located at or near the apex of the conical fluid chamber 432".

The fluid feed tube 406" is attached to the housing 403" and defines a supply channel 430". The supply channel 430" is in fluid communication with the fluid chamber 432" by means of a connecting channel 431". The base of the fluid chamber 432" is formed by the disc-shaped transducer 434". The transducer 434" is

held in position by a hold down plate 402* attached to the housing 403*. The electrical connections to the transducer 434* are of conventional design and are therefore not shown. The housing 403* further comprises a threaded aperture 406* for mounting the jetting head 400*.

The jetting head 400* operates in a manner similar to the jetting heads described above. However, in this jetting head the transducer 434* is normally disk shaped. When the electrical pulse is applied, the transducer 434* bends slightly, thereby altering the volume of the conically shaped jetting chamber 432*. The change in volume of the chamber 432* causes the expulsion of fluid through the orifice 433* and the intake of fluid through the supply channel 430* as described in reference to the jetting head 400.

A fourth preferred embodiment of the jetting head is shown in Fig. 8 and is generally represented as 400*. The jetting head 400* is very similar in form and function to the jetting head 400 and will not be described in detail. The jetting head 400* comprises two symmetrical housing sections. The sections may be connected together by means of apertures 409* and screws, not shown. When assembled, the housing sections 404*, 402* form a T-shaped supply channel 410*.

In operation, the jetting head 400* functions in a manner similar to the jetting head 400. The jetting head 400* is especially suited for use in the continuous mode, but may also be used in the drop on demand mode. In the continuous mode, the fluid is circulated continuously through the supply channel 430* allowing the jetting tube 432* to withdraw as much fluid as required.

By way of illustrating and with no limitations intended the following information is given to further illustrate the above described embodiments. The computer 700 is an IBM Corporation Personal Computer with 640 kbytes of RAM memory. The interface unit 600 is a Burr Brown interface unit model number PC 20001. The plotter 800 is manufactured by Houston Instrument as model number DMP-40. Communication between the plotter 800 and the interface unit 600 is performed through a standard asynchronous serial communication port.

The electrical pulse applied to the jetting head 400 to activate the transducer 434 comprises a rise time of approximately 5 usecs, a fall time of approximately 5 usecs and a pulse width of approximately 35 usecs. When the transducer 434 is operated in the drop on demand mode, the voltage potential of the pulse is 60 volts plus or minus 10 volts and the pulse frequency can be up to 4 khz. When the transducer 434 is operated in the continuous mode, the voltage potential of the pulse is 30 volts plus or minus 10 volts and the pulse frequency can be up to 10 khz.

The jetting tube 432 is manufactured from a pyrex glass tube and measures .027 inches outside diameter and .020 inches inside diameter. The tube is drawn to a closed taper in an electric furnace. The tapered end is then cut and ground to a desired orifice opening of .002 to .004 inches in diameter. The tube is cut to a final length of .945 inches in the case of the dispenser embodiment and ultrasonically cleaned in acetone. After being cleaned and dried the large end of the tube is fire polished. If desired, the orifice end of the tube may receive a coating, such as a hydrophobic polymer, to enhance droplet separation from the tube.

The supply tube 430 is formed from .023 inch inside diameter and .38 inch outside diameter polyethylene tubing produced by Intramedic Corp. as model number #14 170 11B. During assembly, one end of the tubing is stretched over a warm tapered mandrel. The stretched end of the supply tube 430 is then inserted over the large fire polished end of the jetting tube 432. The assembly is then cleaned and baked in a circulating air oven at 50°C. for 10 minutes.

The transducer 434 was purchased from Vernitron of Cleveland, Ohio as model number PZT-5H. The electrodes 437, 436 are comprised of nickel and are separated from each other on the outer surface of the transducer by approximately .030 inches. The jetting tube 432 is inserted into the cylindrical piezo-electric tube 434 and secured with epoxy manufactured by Epoxy Technology of Belenca, Massachusetts as model number 301. The epoxy is applied at the junction of the tube 432 and transducer 434 with a syringe. The epoxy flows along the tube 432 inside the transducer 434 by capillary action. The assembly is then baked in a circulating air oven at 65°C. for one hour to cure the epoxy.

The contact pins 422 are secured to one of the housing sections 402, 404 with a drop of epoxy. The transducer jetting tube 434, 432 is placed in the housing such that the orifice end 433 of the tube 432 protrudes approximately .030 inches from the housing 403, 404. A drop of silver epoxy is placed between each contact pin 422 and the transducer 434 to ensure a secure electrical connection. Epoxy is also applied to the junction of the housing 402, 404 and supply tube 430. The other section of the housing 402, 404 is then screwed into place.

The periphery of the housing 402, 404 is sealed with a capillary sealer such as cyclohexanone. Epoxy is then added around each contact pin 422 and around the orifice end 433. The assembly is then baked in a circulating air oven at 65°C. for one hour.

The filter 300 is formed from a polyester mesh with 30 um pores and positioned in a polypropylene

housing. The air pressure supplied to the reservoir 200 during continuous printing operations is regulated at approximately 10 to 30 psi.

The reagents used have the following characteristics:

Printing (drop on demand mode):

- 5 Fluid viscosity range: 1 - 30 centipoises
- Fluid surface tension: 20 - 70 dyne/cm

Printing (continuous mode):

- Fluid viscosity range: up to 50 centipoises
- Fluid surface tension: not measured

- 10 Dispensing (drop on demand mode):

- Fluid viscosity range: 2 - 30 centipoises
- Fluid surface tension: 20 - 70 dyne/cm

A measure of the performance and selected operating characteristics for a typical jetting head are presented in Figs. 9-11. Fig. 9 is a graph of the mass of a droplet as a function of droplet emission frequency for three fluids. The viscosity of the fluids were 1, 5 and 24 centipoise and the transducer excitation pulse width was 35 microseconds. As shown in Fig. 9, the higher fluid viscosity results in a more stable operating performance of the jetting head. Fig. 10 is a graph of droplet velocity as a function of droplet emission frequency for fluid viscosities of 1, 5 and 24 centipoise. The log of the total fluid weight as a function of the log of the number of droplets emitted is shown in Fig. 11. The fluid used has a viscosity of 2 centipoise, a surface tension of 20 dynes/cm, and a density of .8 grams/cc. The transducer excitation pulse was 80 volts and the excitation frequency was approximately 711 Hz.

Some blood typing reagents and some allergen reagents have very low viscosities and surface tensions. Although in some cases viscosity modifiers, such as glycerol, dextran, glucose, and the like, may be added to increase the viscosity, a few reagents are adversely affected by such modifiers.

25 Developing stable and reproduceable demand mode jetting is difficult with very low viscosities. Although droplet emission can be established at some fundamental frequencies, the droplets dispensed may have small satellite droplets which reduce the accuracy for metering and dispensing applications. However, even with the satellite drops, sufficient reagent is adequately delivered for most print applications without a substantial decrease in print quality.

30 Glycerin may be used as a viscosity modifier to improve jetting reliability and to prevent obstruction of the orifice arising from evaporation of the reagent fluid components. Glycerin has been found specially beneficial for those reagents containing particulate material. The evaporation of the fluid component results in a concentration of glycerin located at the orifice. The plug of glycerin substantially prevents further evaporation of the reagent fluid. During the next activation cycle of the transducer, the plug of glycerin is expelled from the orifice.

35 When operating in the dispensing mode the volume of the droplets can be varied to substantially uniformly contain from 100 pico-liters to 1 micro-liter. The droplets can be produced at a rate of approximately 1 khz to 8 khz. When operating in the printing mode the size of the pel made by each droplet measures approximately .001-.012 inches in diameter.

40 A copy of the program used in the computer 700 for a printing operation is attached hereto as Appendix A. The values, manufacturer and manufacturing part number of the circuit components of the jetting control unit 500 are substantially as follows:

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	Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
10	R39, 45-48, 57, 58	RES. 10KOHM $\frac{1}{2}$ WATT5% C.F.	
	R66	RES. 150OHM $\frac{1}{2}$ WATT5% C.F.	
	R3	RES. 15KOHM $\frac{1}{2}$ WATT5% C.F.	
15	R34	RES. 16KOHM $\frac{1}{2}$ WATT5% C.F.	
	R50	RES. 2.4KOHM $\frac{1}{2}$ WATT1% C.F.	DALE RLO79242G
	R13, 23, 36, 40, 41	RES. 2.4KOHM $\frac{1}{2}$ WATT5% C.F.	
	R56	RES. 20KOHM $\frac{1}{2}$ WATT5% C.F.	
20	R8	RES. 220OHM $\frac{1}{2}$ WATT5% C.F.	
	R6	RES. 27OHM $\frac{1}{2}$ WATT5% C.F.	
	R7, 12, 25	RES. 2KOHM $\frac{1}{2}$ WATT5% C.F.	
	R67	RES. 3.6KOHM $\frac{1}{2}$ WATT5% C.F.	
25	R51, 53	RES. 3.9KOHM $\frac{1}{2}$ WATT5% C.F.	
	R29	RES. 300KOHM $\frac{1}{2}$ WATT5% C.F.	
	R61	RES. 30KOHM $\frac{1}{2}$ WATT1% C.F.	DALE RLO79303G
	R15-18, 26-28, 54, 55, 64	RES. 4.7KOHM $\frac{1}{2}$ WATT5% C.F.	
30	R62	RES. 45.3KOHM $\frac{1}{2}$ WATT1% C.F.	DALE RN55D4532F
	R30, 33	RES. 47OHM $\frac{1}{2}$ WATT5% C.F.	
	R21	RES. 470OHM $\frac{1}{2}$ WATT5% C.F.	
	R19	RES. 47KOHM $\frac{1}{2}$ WATT5% C.F.	
	R35	RES. 510OHM $\frac{1}{2}$ WATT5% C.F.	
35	R43	RES. 6.2KOHM $\frac{1}{2}$ WATT5% C.F.	
	R60	RES. 7.5KOHM $\frac{1}{2}$ WATT5% C.F.	
	R37	RES. 75KOHM $\frac{1}{2}$ WATT5% C.F.	
	R9	RES. 76KOHM $\frac{1}{2}$ WATT1% C.F.	DALE RN60D7622F
	R11	RES. 820OHM $\frac{1}{2}$ WATT5% C.F.	
40	U2, 11, 14, 16, 22	RES. DIP NETWRK. 47KOHM	CT9 761-1R47K
	C21, 41, 45	CAP. AXIAL 1MF@250VDC	MALLORY #TC56
	C24	CAP. AXIAL 220MF@250VDC	MALLORY LP2219250C7P3
	C10	CAP. AXIAL ALUM ELEC. 4700 0MF@25VDC	MALLORY TCG472J025NIC
45	C1, 2, 3, 55, 60	CAP. RADIAL DIPPED TANT. 10MF@25VDC	KEMET T350E106M025AS
	C53	CAP. RADIAL DIPPED TANT. 1MF@35VDC	KEMET T350A105KC35AS
50	C36	CAP. RADIAL DIPPED TANT. 47MF@10VDC	KEMET T350H566MC10AS

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Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
C54	CAP. RADIAL SILV MICA 100PF300VDC	KAHGAN SD5101J301
C57	CAP. RADIAL SILV MICA 20PF300VDC	KAHGAN SP12200J301
C49	CAP. RADIAL SILV. MICA 39PF300VDC	KAHGAN SP12390J301
C39	CAP. RADIAL X7R MLC .015MF@50VDC	KEMET C315C102K1R5CA
C6	CAP. RADIAL X7R MLC .022MF@50VDC	KEMET C315C223K5R5CA
C30, 35, 37	CAP. RADIAL 25U MLC .015MF@50VDC	KEMET C315C153K5R5CA
C4, 7	CAP. RADIAL 25U MLC .01MF@50VDC	KEMET C315C103K5R5CA
C4, 5, 6, 9, 11-19, 22, 23, 25-28 C31-34, 37, 42, 43 47, 48, 50-52 C56, 58, 59	CAP. RADIAL 25U MLC .22MF@50VDC	KEMET C322C224M5U5CA
C46	CAP. VARI. 2-12PF.	JOHANSEN #9626
CR7, 8, 9, 10, 11, 12, 17	DIODE SIL.	ITT. FAIRCHILD. 1N4148
CR1, 2, 3, 4	DIODE SIL. FAST	GENL. INST. EGP10D
CR5	DIODE SIL. FASTHIVOLT	GENL. INST. UF4007
CR6, 13, 15	DIODE SIL. REF. 2, 500VDC	NATL. SEMI-LM3852-2.5
CR14, 16	DIODE SIL. ZENER 3.5V. 25WATT	MOTOROLA 1N4622A
U6, 13, 15, 17	SWITCH 8 POSITION DIP	CTS 206-8
Q2, 9, 12	TRANSTOR. COMMON NPN	MOTOROLA 2N2222A
Q8, 10, 11	TRANSTOR. COMMON PNP	MOTOROLA 2N2907A
Q4	TRANSTOR. HIVOLTHIFREQ. NPN	MOTOROLA MPSU10
Q7	TRANSTOR. HIVOLTHIFREQ. PNP	MOTOROLA MPSU60
Q1	TRANSTOR. HIVOLTHIINPN	TI, MOTOROLATIP48
Q3, 14	TRANSTOR. HIVOLTNPN2N3439	MOTOROLA 2N3439
Q13	TRANSTOR. HIVOLTPNF	MOTOROLA MJES731
U5, 27	IC 1-SHOT 74HC221	NATL. SEMI MM74HC221N
U23, 26	IC 1-SHOT 74LS221	NATL. SEMI DM741S221N
U7-10	IC COMPARATOR 74HC688	NATL. SEMI MM74HC688N
U30	IC CONVERTER DAC0800	NATL. SEMI DAC0800LCN
U24, 25	IC COUNTER 74HC193	NATL. SEMI MM74HC193N
U28	IC HI SLEW HI VOLT OP AMP	BURR-BROWN 3584JM
U1	IC HYBRID DC/DC CONVERTER	BURR-BROWN MODEL 724
U4	IC OC DRIVER SN7406	NATL. SEMI DM7406N
U3	IC OCTAL LATCH 74HC374	NATL. MM74HC374N
U12, 29, 31, 32	IC OP AMP LF256	NATL. SEMI LF256H
U18, 19, 20, 21	IC OPTO ISOLATOR	HEWLETT-PCKRD HCPL2300
R24, 42, 63	POT100KOHM $\frac{1}{2}$ WATT10%	BOURNS 3622-1-104
R38, 49, 52	POT10KOHM $\frac{1}{2}$ WATT10%	BOURNS 3622W-1-103
R20	POT25KOHM $\frac{1}{2}$ WATT10%	BOURNS 3622W-1-253
R14, 31	POT2KOHM $\frac{1}{2}$ WATT10%	BOURNS 3622W-1-202

<u>Ref. Numeral of Component</u>	<u>Description and Value</u>	<u>Manufacturer and Part No.</u>
	REGULATOR 5VDC	NATL. LM340T-5.0
5 VRI		
R10	RES. 1MEG OHM $\frac{1}{4}$ WATT 5% C.F.	
R2, 4	RES. 1.2K OHM $\frac{1}{4}$ WATT 5% C.F.	
R32	RES. 1.6K OHM $\frac{1}{4}$ WATT 5% C.F.	
R44	RES. 1.8K OHM $\frac{1}{4}$ WATT 5% C.F.	
R1	RES. 10MEG OHM $\frac{1}{4}$ WATT 5% C.F.	
10 R5, R22	RES. 100 OHM $\frac{1}{4}$ WATT 5% C.F.	
R65	RES. 100K OHM $\frac{1}{4}$ WATT 5% C.F.	
R59	RES. 10K OHM $\frac{1}{4}$ WATT 1% C.F.	DALE RN55D1002F
R100	RES. 270 OHM	
R101, 108	RES. 470 OHM	
15 R102, 103	RES. 1K OHM	
106, 109, 110		
R104	RES. 4700 OHM	
R105	PCT. 100K OHM	
R107	PCT. 10K OHM	
20 R111, 113	RES. 220 OHM	
R112	RES. 22 OHM	
R114, 115	RES. 47 OHM	
C100	CAP. 10MEG 035 VFC	
C108	CAP. 10000 PF	
25 D100	DIODE	1N4148
Q100, 105	TRANSTOR	2N2222
Q101, 102	TRANSTOR	2N3906
Q103, 104	TRANSTOR	2N3904
U100, U108	IC 1-SHOT	74LS123
30 U103, 104	IC INVERTOR	74LS04
105, 106		
U108	IC LINE DECODER	74LS138

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the transducer could be of a type other than piezo-electric such as magneto-strictive, electro-strictive, and electro-mechanical. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

APPENDIX

5 Reagent Jet Printer
Reagent Calibration

PAGE 1

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12:24:57

IBM Personal Computer BASIC Compiler V2.00

```

Offset Data Source Line
20 0030 0006 REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Reagent Calibration' $LINESIZE: 132
0030 0006 'NOZZLE - "RECAL"
0030 0006
0030 0006 'AUTHOR - M. A. Enevold
0030 0006
0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030 0006 'REVISION - 2.0 07-01-86 NAE Microfab modifications
15 0030 0006 ' - 1.0 02-11-86 NAE Creation of initial code
0030 0006
0030 0006 'SYSTEM - This code can only be compiled by the BASCOM
0030 0006 'COMPILER, it will not run under the INTERPRETER!!
0030 0006
0030 0006 'DESCRIPTION:
20 0030 0006 ' The reagent calibrate module presents a menu with 12 items arranged
0030 0006 ' in 3 columns of 4 rows. The arrow keys allow movement around the
0030 0006 ' table, the + and - keys increment or decrement values in the first
0030 0006 ' column, and the enter key executes commands in the third column.
0030 0006 ' The second column is an array of ASCII strings representing reagent name,
25 0030 0006 ' concentration, density, and viscosity. The values entered in column one
0030 0006 ' are drop frequency, pulse width, strobe delay, and nozzle number.
0030 0006 ' The commands in the third column are start/stop, load, save, and exit.
0030 0006
0030 0006 'DATA DICTIONARY
0030 0006 '
0030 0006 ' MENUZ Pointer to which menu item is active (0-11)
30 0030 0006 ' MENU$(17,1) Array for strings used to display the menu
0030 0006 ' MENU(17,4) Array for numbers in the menu display
0030 0006 ' DIFF1 Differential to move MENUZ at arrow key input
0030 0006 ' TYPEZ Pointer set during menu scan to direct action
0030 0006 ' KEYBUF$ Storage for string input from menu display
0030 0006 ' AS Destination for single keystroke inputs
0030 0006 ' FILES String where filename is built for reagent data file
35 0030 0006 ' REANAMES String where reagent name is stored
0030 0006 ' RZ Row to display special graphics character in menu
0030 0006 ' CZ Column to display special graphics character in menu
0030 0006 ' NZ Special graphics character is read into here
0030 0006 ' OLD.AMP.VALUEZ Integer value for setting pulse amplitude
40 0030 0006 ' DIG.VALZ Value set to digital port 0 to inc/dec amplitude
0030 0006
0030 0006 $END REAGENT.CALIBRATE STATIC
0047 0006
0047 0006 DIM MENU$(17,1),MENU(17,4)
0048 01FE
45 0048 01FE GOSUB INITIALIZE: 'read init. values and set screen
004E 01FE
004E 01FE WRITE TYPEZ (&)
0051 0200
0051 0200 TYPEZ = 0
0060 0200 AS = ""
50 006A 0204
006A 0204 WRITE AS = ""
0079 0204 AS = INKEY$
0083 0204 IF ACTIVEZ = 1 AND COUNTIME < TIMER THEN GOSUB PEN.DOWN
00AD 0204
0080 0204
55

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Reagent Jet Printer
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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
25 0080	020A	IF AS = CHR\$(13) THEN TYPE1 = 1: 'execute (cr)
00CA	020A	IF AS = "+" THEN TYPE1 = 2: 'increment variable
00E0	020A	IF AS = "-" THEN TYPE1 = 3: 'decrement variable
00F6	020A	IF AS = CHR\$(0) + CHR\$(72) THEN TYPE1 = 4: 'up arrow key
0118	020A	IF AS = CHR\$(0) + CHR\$(80) THEN TYPE1 = 5: 'down arrow key
0140	020A	IF AS = CHR\$(0) + CHR\$(75) THEN TYPE1 = 6: 'left arrow key
30 0145	020A	IF AS = CHR\$(0) + CHR\$(77) THEN TYPE1 = 7: 'right arrow key
018A	020A	IF AS > CHR\$(47) AND AS < CHR\$(123) THEN TYPE1 = 8: 'ascii 0 - z
01C2	020A	ON TYPE1 GOSUB T1, T2, T3, T4, T5, T6, T7, T8
01DB	020A	WEND
01DB	020A	TYPE1 = 0
35 01DF	020A	EXIT SUB
01E6	020A	REMARK PAGE
01E6	020A	
01EA	020A	

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5 Reagent Jet Printer
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IEN Personal Computer BASIC Compiler V2.00

```

Offset Data Source Line
10 01EA 020A ***** SUBROUTINES FOR THIS MODULE *****
01EA 020A
01EA 020A T1: '(<cr> execute command
01EF 020A IF MENU(12,0) = "START" THEN TYPE1 = 0:RETURN: 'exit to print menu, no action
0205 020C OK MENU(12,0) = "STOP" THEN GOSUB T1A, T1B, T1C, T1D
021A 020C IF MENU(12,0) = "STOP" THEN TYPE1 = 0
022C 020C RETURN
15 0230 020C
0230 020C T1A: 'start/stop drop flow
0233 020C IF MENU(12,0) = "START" THEN GOSUB START.INX
023A 020C IF MENU(12,0) = "STOP" THEN GOSUB STOP.INX
027F 020C MENU(12,0) = TEMP1
029A 0210 COLOR 0,7:GOSUB DISPMENU
20 02AC 0210 RETURN
02B0 0210
02B0 0210 START.INX:
02B5 0210 TEMP1 = "STOP"
02BF 0210 CALL DOT.ON: 'is module PCI
02C9 0210 LOCATE 17,7:COLOR 27,0:PRINT "PRINTING";
25 02F1 0210 ACTIVE1 = 1
02F8 0210 RETURN
02FC 0210
02FC 0210 STOP.INX:
0301 0210 TEMP1 = "START"
0308 0210 CALL DOT.OFF: 'is module PCI
30 0317 0210 LOCATE 17,7:COLOR 15,0:PRINT " ";
0330 0210 ACTIVE1 = 0
0344 0210 RETURN
0346 0210
0348 0210 T1B: 'load reagent profile
35 0349 0210 IF MENU(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";GOSUB ANYKEY:RETURN
0391 0210
0391 0210 GOSUB SEARCH
0397 0210
0397 0210 IF 12 < (REAMUX + 1) THEN GOTO FOUND
03A8 0214 LOCATE 25,10-LEN(MENU(6,1))/2:PRINT MENU(6,1); " not Found";
40 0404 0214 GOSUB ANYKEY: 'wait for a keyhit
0404 0214 RETURN
040E 0214
040E 0214 FOUND:
0413 0214 FILES = RIGHTS(STR$(12),LEN(STR$(12))-1) + ".REA.BJT"
0437 0218 OPEN FILES FOR INPUT AS #1: 'set pattern data file for read
45 0440 0218 INPUT #1,MENU(10,0): 'read frequency
0448 0218 INPUT #1,MENU(11,0): 'read amplitude
0468 0218 INPUT #1,MENU(12,0): 'read stroke delay
04AE 0218 INPUT #1,MENU(13,0): 'read pulse width
04D1 0218 INPUT #1,MENU(14,0): 'read rise time
04F4 0218 INPUT #1,MENU(15,0): 'read fall time
50 0519 0218
0519 0218 INPUT #1,MENU(17,1): 'read concentration
0539 0218 INPUT #1,MENU(18,1): 'read density
0541 0218 INPUT #1,MENU(19,1): 'read viscosity
0585 0218 INPUT #1,MENU(20,1): 'read surface tension
55 05A7 0218

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5 Reagent Jet Printer
Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
05A9	0218	CLOSE #1: 'done with data file
10 05B0	0218	OPEN "SEADIR.RJP" FOR OUTPUT AS #1
05B0	0218	PRINT #1,FILES: 'save filename in default file
05C2	0218	PRINT #1,REXUS(6,1): 'save the directory name as well
05D2	0218	CLOSE #1
05F4	0218	GOSUB DISP.PARMS: 'show all parameters
05FB	0218	RETURN
15 0601	0218	
0605	0218	TIC: 'save reagent profile
0605	0218	IF REXUS(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";GOSUB ANYKEY:RETURN
060A	0218	OPEN "READIR.RJP" FOR INPUT AS #1
061E	0218	INPUT #1,REANUM1
063F	0218	CLOSE #1
20 0671	0218	IF REANUM1 < 80 THEN GOTO SAVE.REA
0678	0218	LOCATE 25,1:PRINT "Directory is Full (80 reagents max.)"
0687	0218	GOSUB ANYKEY:RETURN
06A1	0218	
06AB	0218	SAVE.REA:
06B0	0218	GOSUB SEARCH
25 06B6	0218	IF I1 > REANUM1 THEN GOTO SAVEREAL
06C7	0218	REANUM1 = I1
06CE	0218	COLOR 15,0
06DA	0218	LOCATE 25,1:PRINT REXUS(6,1);" already exists. Replace it with new values? ";
070C	0218	AS = ""
0716	0218	WHILE AS = ""
30 0725	0218	AS = INKEY\$
072F	0218	WEND
0732	0218	LOCATE 25,1:PRINT SPACES(79);
074F	0218	IF AS = "Y" OR AS = "y" THEN GOTO REPLACE
0778	0218	RETURN
077C	0218	
35 077C	0218	SAVEREAL:
0781	0218	KILL "READIR.OLD": 'delete old backup directory
0788	0218	NAME "READIR.RJP" AS "FEADIR.OLD": 'save old directory
0792	0218	OPEN "READIR.OLD" FOR INPUT AS #1
07A3	0218	OPEN "READIR.RJP" FOR OUTPUT AS #2: 'set up new dir
40 07B5	0218	INPUT #1,REANUM1: 'read number of dir entries
07B5	0218	REANUM1 = REANUM1 + 1: 'increase by 1
07C7	0218	WRITE #2,REANUM1: 'save in new directory
07D9	0218	
07E1	0218	FOR I=1 TO REANUM1 - 1
07FA	021C	LIKE INPUT #1,AS: 'read entry from old dir
45 0807	021C	PRINT #2,AS: 'write entry in new directory
0817	021C	NEXT I
0832	0220	
0832	0220	CLOSE #1
0839	0220	
50 0839	0220	PRINT #2,REXUS(6,1): 'write new entry to new directory
083B	0220	CLOSE #2: 'done with directory
0842	0220	
0842	0220	REPLACE:
0847	0220	FILES = RIGHTS(STR\$(REANUM1),LEN(STR\$(REANUM1))-1) + "REA.RJP"
0858	0220	

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Offset	Data	Source Line
10 0688	0220	OPEN FILES FOR OUTPUT AS #1: 'create new pattern data file
0890	0220	WRITE #1,MENU(0,0): 'store frequency
0898	0220	WRITE #1,MENU(1,0): 'store amplitude
08DC	0220	WRITE #1,MENU(2,0): 'store strobe delay
08FD	0220	WRITE #1,MENU(3,0): 'store pulse width
091E	0220	WRITE #1,MENU(4,0): 'store rise time
15 093F	0220	WRITE #1,MENU(5,0): 'store fall time
0962	0220	
0962	0220	WRITE #1,MENU(7,1): 'store concentration
0984	0220	WRITE #1,MENU(8,1): 'store density
09A6	0220	WRITE #1,MENU(9,1): 'store viscosity
09CB	0220	WRITE #1,MENU(10,1): 'store surface tension
20 09EA	0220	
09EA	0220	CLOSE #1: 'done with data file
09F1	0220	
09F1	0220	OPEN "READER.RJP" FOR OUTPUT AS #1
0A03	0220	PRINT #1,FILES: 'save filename in default file
0A13	0220	PRINT #1,MENU(6,1): 'save the directory name as well
25 0A35	0220	CLOSE #1
0A3C	0220	RETURN
0A40	0220	
0A40	0220	SEARCH:
0A45	0220	OPEN "READER.RJP" FOR INPUT AS #1
0A56	0220	INPUT #1,REANUMZ: 'read number of patterns in dir
30 0A68	0220	IZ = 1: 'set entry pointer
0A6F	0220	
0A6F	0220	SLOOP:
0A74	0220	LINE INPUT #1,AS: 'read next pattern name from dir
0A81	0220	IF AS = MENU(6,1) THEN GOTO SEARCH.DONE: 'compare name with dir entry
0AAS	0220	IZ = IZ + 1
35 0AAE	0220	IF IZ < (REANUMZ + 1) THEN GOTO SLOOP: 'check for done
0AC1	0220	SEARCH.DONE:
0AC6	0220	CLOSE #1
0ACD	0220	RETURN
0AD1	0220	
40 0AD1	0220	TID: 'return with no change to exit reagent calibrate
0AD6	0220	PRINT #3,"UH";
0AE6	0220	CLOSE #3: 'close cno channel
0AE9	0220	RETURN
0AF1	0220	
0AF1	0220	TZ: 'process "+" key
45 0AF6	0220	IF MENUZ > 5 THEN RETURN
0B05	0220	MENETIME = TIMER
0B0F	0224	DELTA TIME = MENETIME - OLDTIME
0B1F	022C	OLDTIME = MENETIME
0B29	022C	IF DELTA TIME > 0.15 THEN MULTZ = 1 ELSE MULTZ = MULTZ + 1
0B48	022E	IF MULTZ > 100 THEN MULTZ = 100
50 0B58	022E	MENU(MENUZ,0) = MENU(MENUZ,0) + MENU(MENUZ,3) * MULTZ: 'add increment
0B9F	022E	IF MENU(MENUZ,0) > MENU(MENUZ,1) THEN MENU(MENUZ,0) = MENU(MENUZ,1): 'check max value
0C06	022E	COLOR IS,1:GOSUB DISPMENU:RETURN: 'show new value
0C10	022E	
0C10	022E	T3: 'process "-" key
0C22	022E	IF MENUZ > 5 THEN RETURN
55 0C31	022E	MENETIME = TIMER

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
10 0C38	022E	DELTA TIME = NEWTIME - OLDTIME
0C48	022E	OLDTIME = NEWTIME
0C55	022E	IF DELTA TIME > 0.15 THEN MULT1 = 1 ELSE MULT1 = MULT1 + 1
0C77	022E	IF MULT1 > 100 THEN MULT1 = 100
0C89	022E	MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3) + MULT1: 'sub increment
0CC8	022E	IF MENU(MENUZ,0) < MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,2): 'check min value
15 0032	022E	COLOR 15,1:GOSUB DISPMENU:RETURN: 'show new value
0049	022E	
0049	022E	T4: 'process up arrow key
004E	022E	IF MENUZ MOD 6 = 0 THEN RETURN: 'in top row already
0063	022E	DIFFZ = -1:GOSUB MENPMENU:RETURN: 'move pointer up one
0074	0230	
20 0074	0230	T5: 'process down arrow key
0079	0230	IF MENUZ MOD 6 = 5 THEN RETURN: 'in bottom row already
008F	0230	DIFFZ = 1:GOSUB MENPMENU:RETURN: 'move pointer down one
00A0	0230	
00A0	0230	T6: 'process left arrow key
00A5	0230	IF INT(MENUZ / 6) = 0 THEN RETURN: 'in left column already
25 00C5	0230	DIFFZ = -6:GOSUB MENPMENU:RETURN: 'move pointer one left
00D6	0230	
00D6	0230	T7: 'process right arrow key
00DB	0230	IF INT(MENUZ / 6) = 2 THEN RETURN: 'in right column already
00FE	0230	DIFFZ = 6:GOSUB MENPMENU:RETURN: 'move pointer one right
0E0F	0230	
30 0E0F	0230	T8: 'input keys into KEYBUFs until (cr) is entered
0E14	0230	IF MENUZ > 10 THEN RETURN
0E23	0230	LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0E35	0230	KEYBUFs = AS
0E5F	0234	WHILE AS <> CHR\$(13)
0E72	0234	LOCATE 25,47:PRINT SPACE\$(15);
35 0E8F	0234	LOCATE 25,47:PRINT KEYBUFs;
0EA9	0234	AS = ""
0EB3	0234	WHILE AS = ""
0EC2	0234	AS = INKEY\$
0ECC	0234	IF ACTIVE1 = 1 AND OLDTIME < TIMER THEN GOSUB PEN.DOWN
0EF6	0234	WEND
40 0EF9	0234	IF AS = CHR\$(8) AND LEN(KEYBUFs) > 0 THEN KEYBUFs = LEFT\$(KEYBUFs,LEN(KEYBUFs)-1)
0F38	0234	IF AS = CHR\$(13) AND LEN(KEYBUFs) < 15 THEN KEYBUFs = KEYBUFs + AS
0F75	0234	WEND
0F79	0234	
0F88	0234	IF MENUZ > 5 THEN GOTO STORESTRNG
45 0F88	0234	TEMP = VAL(KEYBUFs) 'temp has value of keys input
0F98	0238	
0F98	0238	'round off temp according to step size in menu array
0F98	0238	TEMP = INT(TEMP / (MENU(MENUZ,3) + .5)) + MENU(MENUZ,3)
0FB1	0238	
50 0FB1	0238	'test TEMP for maximum and minimum values in menu array
1010	0238	IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
104F	0238	IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
104F	0238	
104F	0238	'insert new value into menu array and update screen
1068	0238	MENU(MENUZ,0) = TEMP
55 1068	0238	LOCATE 25,30:PRINT SPACE\$(40);



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IBM Personal Computer BASIC Compiler V2.00

Offset	Date	Source Line
70 1080	0238	COLOR 0,7:GOSUB DISPMENU
109A	0238	RETURN
109E	0238	
109E	0238	SIGRESTRING:
10A3	0238	MENU\$(MENUZ,1) = KEYBUF\$
10BF	0238	LOCATE 25,30:PRINT SPACE\$(40);
15 10DC	0238	COLOR 0,7:GOSUB DISPMENU
10EE	0238	RETURN
10F2	0238	
10F2	0238	PEN.DOWN:
10F7	0238	DOWNTIME = TIMER + 1
1107	0238	PRINT 03,"B";
20 1117	0238	RETURN
1118	0238	
1118	0238	ANYKEY:
1120	0238	LOCATE 25,44:PRINT "Strike any key..";
113A	0238	AS = ""
1144	0238	WHILE AS = ""
25 1153	0238	AS = INKEY\$
115D	0238	WEND
1160	0238	LOCATE 25,1:COLOR 15,0:PRINT SPACE\$(79);:COLOR 15,1
1196	0238	RETURN
119A	0238	
119A	0238	NEWMENU: 'write old ites in yellow, point to and highlight new ites
30 119F	0238	COLOR 14,0:GOSUB DISPMENU
11B1	0238	MENUZ = MENUZ + DIFFZ
11BD	0238	IF MENUZ = 11 THEN MENUZ = 10
11CF	0238	IF MENUZ > 15 THEN MENUZ = 15
11E1	0238	COLOR 0,7:GOSUB DISPMENU:RETURN
11F7	0238	
35 11F7	0238	INITIALIZE:
11FC	0238	'change to second screen and display messages
11FC	0238	SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,28:PRINT "Initializing Menu Display";
1240	0238	LOCATE 12,31:PRINT "Please Wait..."
125A	0238	
125A	0238	'initialize variables
40 125A	0238	
125A	0238	ACTIVEZ = 0: not printing
1261	0238	
1261	0238	'initialize plotter cse channel
1261	0238	
1261	0238	OPEN "COM1:2400,N,8,2" AS #3
45 1273	0238	PRINT #3,";UECS,EFV1,M";
1283	0238	
1283	0238	'initialize digital port
1283	0238	SCRX = 4
128A	023A	CALL DIGITAL.OUT(SCRX)
129A	023A	SCRX = 0
50 12A1	023A	CALL DIGITAL.OUT(SCRX); 'pulse reset line to set amplitude to OV.
12B1	023A	SCRX = 4
12B9	023A	CALL DIGITAL.OUT(SCRX)
12C8	023A	
12C8	023A	'set hardware pulse width
55 12C8	023A	CALL SET.OUT.WIDTH(5) 'in module PCI

5 Reagent Jet Printer
Reagent Calibration

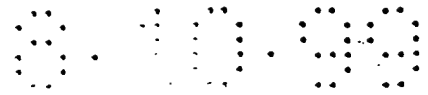
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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
10 120E	023C	'initialize menu arrays'
120E	023C	RESTORE ARRDATA
120E	023C	FOR I=0 TO 17
12E3	023C	READ MENU(11,0),MENU(12,1):
12E8	023C	READ MENU(12,1),MENU(12,2),MENU(12,3),MENU(12,4)
1318	023C	NEXT I
15 137C	023C	'set default reagent values
138F	023C	
138F	023C	
138F	023C	MENU(0,0) = 2000: 'frequency
138F	023C	MENU(1,0) = 0: 'amplitude
13A8	023C	MENU(2,0) = 1: 'strobe delay
20 13C4	023C	MENU(3,0) = 090: 'pulse width
13E0	023C	MENU(4,0) = 470: 'rise time
13FC	023C	MENU(5,0) = 070: 'fall time
1418	023C	
1436	023C	
1436	023C	MENU(6,0) = 0: 'none
25 1452	023C	MENU(7,0) = 0: 'concentration
146E	023C	MENU(8,0) = 0: 'density
148A	023C	MENU(9,0) = 0: 'viscosity
14A6	023C	MENU(10,0) = 0: 'surface tension
14C2	023C	
14C2	023C	OLD.AMP.VALUEX = 0 'initial value of 0 volts
30 14C9	023E	'change active displayed screens to first screen to draw and display parameters
14C9	023E	
14C9	023E	
14C9	023E	SCREEN 0,0,0,1:CLS
14E6	023E	
14E6	023E	COLOR 13:LOCATE 1,32:PRINT "REAGENT CALIBRATE";
35 1507	023E	COLOR 9
150E	023E	FOR I=2 TO 79
1518	023E	LOCATE 3,1:PRINT "P";LOCATE 5,1:PRINT "S";LOCATE 19,1:PRINT "B";
156F	023E	NEXT I
158A	023E	FOR I=4 TO 18
1594	023E	LOCATE 1,1:PRINT "J";LOCATE 1,28:PRINT "I";LOCATE 1,69:PRINT "C";LOCATE 1,80:PRINT "J";
40 1608	023E	NEXT I
1626	023E	RESTORE TABLE
1629	023E	FOR I=1 TO 12
1637	023E	READ RI,CI,XI:LOCATE RI,CI:PRINT CHR\$(XI);
166A	0244	NEXT I
45 1685	0244	'print three headings and instructions
1685	0244	COLOR 10,0
1685	0244	LOCATE 4,7:PRINT "ORCP PARAMETERS";
1691	0244	LOCATE 4,39:PRINT "REAGENT PARAMETERS"
16A8	0244	LOCATE 4,71:PRINT "COMMANDS";
16C5	0244	
50 16DF	0244	COLOR 7:LOCATE 21,20:PRINT "Use ";COLOR 15:PRINT CHR\$(27);CHR\$(32);CHR\$(26);
16DF	0244	PRINT CHR\$(32);CHR\$(24);CHR\$(32);CHR\$(25);COLOR 7:PRINT " to position highlighted cursor";
1729	0244	LOCATE 22,18:PRINT "Use ";COLOR 15:PRINT "+";COLOR 7:PRINT " or ";COLOR 15:PRINT "-";
1768	0244	COLOR 7:PRINT " to scroll current value up or down";
178E	0244	LOCATE 23,26:PRINT "Use ";COLOR 15:PRINT "BT";COLOR 7:PRINT " to activate selection";
17D2	0244	
55 1814	0244	



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Reagent Jet Printer
Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
25	1814 0244	DISP.PARMS:
	1819 0244	'display 18 menu choices in yellow
	1819 0244	
	1819 0244	COLOR 14,0
	1823 0244	FOR MENUZ = 0 TO 17
30	1829 0244	GOSUB DISPREMU
	1831 0244	NEXT MENUZ
	1841 0244	
	1841 0244	'set for reagent name and highlight it
	1841 0244	MENUZ = 6:COLOR 0,7
	1854 0244	GOSUB DISPREMU
35	185A 0244	
	185A 0244	SCREEN 0,0,0,0
	186F 0244	RETURN
	1873 0244	REM SPAGE

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IBM Personal Computer BASIC Compiler V2.00

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10 Offset Data Source Line

1873 0244 DISPMENU:
1878 0244 LOCATE (MENUZ MOD 6)*2+7,(INT(MENUZ/6)*28+2)+(5*INT(MENUZ/12))
1884 0244 PRINT MENUZ(MENUZ,0)
18F2 0244 IF MENUZ > 5 THEN GOTO SHOWSTRING: 'no value to display
1901 0244 LOCATE (MENUZ MOD 6)*2+7,MENU(MENUZ,4)
1933 0244 PRINT USING MENUZ(MENUZ,1);MENU(MENUZ,0);
1966 0244 IF MENUZ > 2 THEN RETURN
1975 0244 ON MENUZ+1 GOSUB SET.FREQ, SET.AMP, SET.DELAY
1986 0244 RETURN

20 198A 0244 SHOWSTRING:
198F 0244 IF MENUZ > 10 THEN RETURN
199E 0244 LOCATE (MENUZ MOD 6)*2+7,48
198A 0244 PRINT "
19C7 0244 LOCATE (MENUZ MOD 6)*2+7,48
19E3 0244 PRINT MENUZ(MENUZ,1)
25 1A02 0244 RETURN
1A06 0244
1A06 0244 SET.FREQ:
1A08 0244 TEMP = MENU(0,0)
1A24 0244 CALL SET.DUT.RATE(TEMP): 'in module PCI
1A34 0244 LEDZ = 3-INT((TEMP+500)/1000)
30 1A57 0246 IF LEDZ < 0 THEN LEDZ = 0
1A69 0246 SCRZ = 4 + (LEDZ * 32): 'set LED intensity
1A89 0246 CALL DIGITAL.OUT(SCRZ): 'in module PCI
1A99 0246 RETURN
1A98 0246
1A98 0246 SET.AMP:
35 1AA2 0246 SCRZ = CINT(MENU(MENUZ,0) * 255 / 150): 'convert volts to binary number
1AC8 0246 IF SCRZ = OLD.AMP.VALUE THEN RETURN
1ADC 0246 TEMP1 = SCRZ - OLD.AMP.VALUE: 'calculate delta
1AE8 0246 OLD.AMP.VALUE = SCRZ: 'update old value to current value
1AEF 0246 DIG.VAL1 = 6
1AF6 0246 IF TEMP1 < 0 THEN DIG.VAL1 = 5
40 1B08 0246 TEMP1 = ABS(TEMP1)
1B15 0246 FOR IZ = 1 TO TEMP1
1B22 024C SCRZ = DIG.VAL1 + (32*LEDZ)
1B3F 024C CALL DIGITAL.OUT(SCRZ): 'pulse higher or lower
1B4F 024C SCRZ = 4 + (32 * LEDZ)
1B6F 024C CALL DIGITAL.OUT(SCRZ): 'set port to normal
45 1B7F 024C NEXT IZ
1B91 024C RETURN
1B95 024C
1B95 024C SET.DELAY:
1B9A 024C TEMP = MENU(2,0)
1B96 024C CALL SET.STROBE.DELAY(TEMP): 'in module PCI
50 18C6 024C RETURN
18CA 024C
18CA 024C REM 3PAGE

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Reagent Jet Printer
 70 Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
18CA	024C	***** DATA USED BY THIS MODULE *****
18CA	024C	
15 18CA	024C	ARRDATA:
18CF	024C	DATA "Frequency" Hz,"88,888",10000,1,1,16
18D1	024C	DATA "Amplitude" V,"888",150,0,1,19
18D3	024C	DATA "Strobe Delay" uS,"88,888.0",15999.5,.5,.5,16
18D5	024C	DATA "Pulse Width" "888",999,0,1,19
18D7	024C	DATA "Rise Time" "888",999,0,1,19
18D9	024C	DATA "Fall Time" "888",999,0,1,19
20 18DB	024C	DATA "Mass",,,0,0,0,0
18DD	024C	DATA "Concentration",,,0,0,0,0
18DF	024C	DATA "Density",,,0,0,0,0
18E1	024C	DATA "Viscosity",,,0,0,0,0
18E3	024C	DATA "Surface Tension",,,0,0,0,0
25 18E5	024C	DATA "",,,0,0,0,0
18E7	024C	DATA "START",,,0,0,0,0
18E9	024C	DATA "LOAD",,,0,0,0,0
18EB	024C	DATA "SAVE",,,0,0,0,0
18ED	024C	DATA "EXIT",,,0,0,0,0
18EF	024C	DATA "",,,0,0,0,0
30 18F1	024C	DATA "",,,0,0,0,0
18F3	024C	
18F3	024C	TABLE:
18F8	024C	DATA 3,1,218
18FA	024C	DATA 3,28,210
18FC	024C	DATA 3,69,210
35 18FE	024C	DATA 3,80,191
1C00	024C	DATA 5,1,198
1C02	024C	DATA 5,28,206
1C04	024C	DATA 5,69,206
1C06	024C	DATA 5,80,181
1C08	024C	DATA 19,1,192
40 1C0A	024C	DATA 19,28,208
1C0C	024C	DATA 19,69,208
1C0E	024C	DATA 19,80,217
1C10	024C	
1C10	024C	END SUB
1C17	024C	
45 1C17	024C	
23EB	024C	

50426 Bytes Available
 43960 Bytes Free

50 0 Warning Error(s)
 0 Severe Error(s)

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Reagent Jet Printer
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

```

5      0030 0006 REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Pattern Entry/Modif
      0030 0006 ication'
      0030 0006 'MODULE - 'PATENT' Pattern creation, modification, and filing
      0030 0006 '
10     0030 0006 'AUTHOR - M. A. Enevold
      0030 0006 '
      0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006 '
      0030 0006 'REVISION - 1.2 03-10-86 NAE Remove Mouse inputs
15     0030 0006 '          1.1 02-20-86 NAE Add 80 pattern limit to save
      0030 0006 '          1.0 01-13-86 NAE Creation of initial code
      0030 0006 '
      0030 0006 'SYSTEM - This code can only be compiled by the BASCOM
      0030 0006 '          COMPILER, it will not run under the INTERPRETER!!
20     0030 0006 '
      0030 0006 'DESCRIPTION:
      0030 0006 '          This module allows the user to LOAD, SAVE, DIRectory, D
      0030 0006 RAW and
25     0030 0006 '          enter repeat count and other parameters for a pattern t
      0030 0006 o be printed.
      0030 0006 '          The low-resolution graphics mode is selected and a menu
      0030 0006 is displayed
      0030 0006 '          across the bottom of the screen. Using arrow keys
30     0030 0006 '          point to the action to be taken and then invoke that ac
      0030 0006 tion with the
      0030 0006 '          Enter key. In the RAW mode, another menu is
      0030 0006 '          displayed which allows the user to select from LINE, RE
      0030 0006 CTangle,
      0030 0006 '          Solid RECTangle, or CIRCLE pattern elements.
35     0030 0006 '
      0030 0006 'DATA DICTIONARY
      0030 0006 '          SCNDATZ(50,5) 51 Row (Elements) by 6 Column array f
      0030 0006 or storing pattern elements
40     0030 0006 '          CURSORZ(9) Storage for cursor graphics icon
      0030 0006 '          MENU$(6) Up to 7 menu names can be saved here
      0030 0006 '          ELNUMZ Count of number of elements in a patt
      0030 0006 ern
      0030 0006 '          IX YZ Current location of graphics cursor
      0030 0006 '          GRID Value of one dot space on the screen
45     0030 0006 (default is 0.005")
      0030 0006 '          ROWZ COLZ Location to print instructions
      0030 0006 '          AS Storage for single key-strokes or inp
      0030 0006 ut strings
50     0030 0006 '          MENUMUM Which menu is being displayed (1 or 2
      0030 0006 )
      0030 0006 '          ITEM Pointer to which menu item is highlig
      0030 0006 hted (0 - 6)
      0030 0006 '          REPEATZ Number of times pattern is to be repe
      0030 0006 ated when printed
55     0030 0006 '          XOFF YOFF X and Y axis distance between the pri
      0030 0006 nting of repeated patterns
      0030 0006 '          ROWSP COLSP Row and Column spacing for printing m
      0030 0006 ultiple sets of patterns

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Reagent Jet Printer
Pattern Entry/Modification

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

0030 0006 * PATNUMZ - Number of patterns stored in
the pattern directory PATDIR.RJP

0030 0006 * BROWZ BCOLI Row and Coluan location to display di
rectory entrys

0030 0006 * NAMES Pattern name to be LOAded or SAVED to
directory

0030 0006 * IZ JZ Counters used to LOAD or SAVE the ele
ment data from/to pattern data file

0030 0006 * FILE\$ Name of pattern data file

0030 0006 * TEMPZ Which type of element is being drawn.
1 = Line 2 = Rectangle

0030 0006 *
3 = Solid Rectangle 4 = Circle

0030 0006 * FLAGZ Same as TEMPZ above

0030 0006 * STARTMSG\$ ENDMSG\$ Message display for startpoint and en
dpoint of element entry

0030 0006 * X1Z Y1Z Starting cursor position for
element being drawn

0030 0006 * DXZ DYZ Delta X and Y values used to
re-position cursor after arrow key

0030 0006 * MAXITEM The highest number item in th
e current menu display

0030 0006 * XS XE Starting and ending X position of the
menu highlighting blue box

0030 0006 * RADIUSZ The calculated radius of a ci
rcle to be displayed

0030 0006 REM \$PAGE

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Reagent Jet Printer
Pattern Entry/Modification

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10	Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
	0030	0006	SUB PATENTRY STATIC	
	0047	0006		
	0047	0006	WIDTH 40:SCREEN 1:CLS	
15	005F	0006	DIM SCNDAT\$(50,5),CURSOR\$(9),MENU\$(6)	
	0060	029A	ELNUM1 = 0:X1=0:Y1=0:GRID = 0.005	
	007F	02A4		
	007F	02A4	LINE (0,0)-(6,6),,8	
	00A1	02A4	LINE (0,3)-(6,3),,8	
20	00C5	02A4	LINE (3,0)-(3,6),,8	
	00E9	02A4	PRESET (3,3)	
	00F5	02A4	GET (0,0)-(6,6),CURSOR\$	
	0116	02A4	CLS	
	011D	02A4		
25	011D	02A4	LINE (0,0)-(319,190),,8	
	0140	02A4		
	0140	02A4	RESTORE INSTRU	
	0147	02A4	FOR I=1 TO 4	
	0151	02A4	READ ROWZ,COLZ,A\$	
30	0164	02AC	LOCATE ROWZ,COLZ:PRINT A\$;	
	0180	02AC	NEXT I	
	019B	02B0		
	019B	02B0	FIRST:	
	01A0	02B0	MENUNUM = 1	
35	01AA	02B4	GOSUB SUBMENU	
	01B0	02B4		
	01B0	02B4	ON ITEM + 1 GOTO PATDIR, PATLOAD, PATSAVE, PATDRAW, REP	
			EAT, PATEXT	
	01CD	02B8	GOTO FIRST	
40	01D0	02B8		
	01D0	02B8	REPEAT:	
	01D5	02B8	GOSUB ITEMBOXERASE: 'erase blue box around DIR	
	01DB	02B8	LOCATE 25,1:PRINT SPACES(39); 'erase menu line	
	01FB	02B8	LOCATE 25,1:INPUT;"Enter Repeat Count ",REPEAT\$	
45	0218	02BA	LOCATE 25,1:PRINT SPACES(39); 'erase menu line	
	0235	02BA	LOCATE 25,1:INPUT;"Enter X Axis Offset ",XOFF	
	0255	02BE	LOCATE 25,1:PRINT SPACES(39); 'erase menu line	
	0272	02BE	LOCATE 25,1:INPUT;"Enter Y Axis Offset ",YOFF	
	0292	02C2	GOTO FIRST	
50	0296	02C2	PATEXT:	
	0298	02C2	WIDTH 80:SCREEN 0:CLS	
	02B2	02C2	EXIT SUB	
	02B6	02C2	REM \$PAGE	

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Reagent Jet Printer
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

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Offset  Data  Source Line
0286  02C2  PATDIR:          'list directory of patterns
0288  02C2          GOSUB ITEM:ERASE:      'erase blue box around DIR
02C1  02C2          LOCATE 25,1:PRINT SPACE$(39); 'erase menu line
02DE  02C2          OPEN "PATDIR.RJP" FOR INPUT AS #1: 'open directory
                                file
02EF  02C2          INPUT #1, PATNUMZ:      'read number of patterns in dir
                                ectory
0301  02C4          LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
0326  02C4          I = 0:                  'set counter
0330  02C4
0330  02C4  DISLOOP:
0335  02C4          I = I + 1:              'set for next value
0344  02C4          IF I > PATNUMZ THEN GOTO DIREXIT: 'test for done
0358  02C4          IF INT((I-1)/44) <> (I-1)/44 THEN GOTO SHOWNEXT
0384  02C4          IF INT((I-1)/44) < 1 THEN GOTO SHOWNEXT
03A9  02C4          LOCATE 25,1:PRINT "More to Display. Continue ? (Y or N)
03C3  02C4          ";
03C9  02C4          GOSUB CORLOOP: 'wait for Y or N response
                                IF AS = "N" THEN GOTO DIREXIT: 'if N then don't contin
                                ue
03DC  02C4          LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
0401  02C4
0401  02C4  SHOWNEXT:
0406  02C4          ROWZ = ((I - 1) MOD 22) + 2: 'calculate row for disp
                                lay
0422  02C6          COLZ = 4:                'set column to 4
0429  02C6          IF ((I - 1) MOD 44) > 21 THEN COLZ = 23: 'reset column
                                if necessary
044C  02C8          LINE INPUT #1, AS:      'read next name from directory
044C  02C8          LOCATE ROWZ,COLZ:PRINT AS; 'PRINT NAME
0459  02C8          GOTO DISLOOP
0475  02C8
0479  02C8  DIREXIT:
0479  02C8          CLOSE #1:              'terminate access to PATDIR.RJP
047E  02C8          GOTO FIRST
0485  02C8
0489  02C8  REM $PAGE

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Reagent Jet Printer
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	0489 02C9	PATLOAD:
	048E 02C9	GOSUB ITEM\$01ERASE: 'erase blue box around DIR
	0494 02C8	OPEN "PATDIR.RJP" FOR INPUT AS #1
	04A5 02C8	INPUT #1,PATNUMZ: 'read number of patterns in dir
10	04B7 02C9	GOSUB GETNAME: 'prompt for and input pattern n
	04BD 02C9	LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
	04E2 02C8	GOSUB SEARCH
15	04E8 02C8	IF IZ < (PATNUMZ + 1) THEN GOTO FOUND
	04EB 02C8	LOCATE 10,16-(LEN(NAME\$)/2):PRINT NAME\$;" not Found";
	04FC 02C8	LOCATE 12,14:PRINT "Strike Any Key"
	0531 02CE	GOSUB ANYKEY: 'wait for a keyhit
	054B 02CE	GOTO FIRST
20	0551 02CE	FOUND:
	0555 02CE	FILES = RIGHTS(STR\$(IZ),LEN(STR\$(IZ))-1) + "PAT.RJP"
	055A 02CE	OPEN FILES FOR INPUT AS #1: 'set pattern data file
	057E 02D2	for read
25	058F 02D2	INPUT #1,ELNUMZ: 'read number of elements in pat
	05A1 02D2	term
	05B3 02D2	INPUT #1,GRID: 'read grid size
	05C5 02D2	INPUT #1,REPEATZ: 'read repeat count
30	05D7 02D2	INPUT #1,XOFF: 'read x axis offset for repeat
	05E9 02D2	INPUT #1,YOFF: 'read y axis offset for repeat
	05E9 02D2	FOR IZ = 0 TO ELNUMZ - 1
	05F7 02D4	FOR JZ = 0 TO 5
35	05FD 02D4	INPUT #1,SCNCAIZ(IZ,JZ): 'read file into screen
	0621 02D6	array
	0631 02D6	NEXT JZ
	0643 02D6	NEXT IZ
	064A 02D6	CLOSE #1: 'done with data file
40	064A 02D6	OPEN "PATDEF.RJP" FOR OUTPUT AS #1
	065C 02D6	PRINT #1,FILES: 'save filename in defau
	066C 02D6	it file
	067C 02D6	PRINT #1,NAME\$: 'save the directory nam
45	0683 02D6	e as well
	0683 02D6	CLOSE #1
	0687 02D6	GOTO REDRAW
50	0687 02D6	SEARCH:
	068C 02D6	IZ = 1: 'set entry pointer
	0693 02D6	SLOOP:
	0698 02D6	LINE INPUT #1,AS: 'read next pattern name from di
55	06A5 02D6	IF AS = NAME\$ THEN GOTO SEARCH.END: 'compare name w
	06B8 02D6	ith dir.entry
	06C1 02D6	IZ = IZ + 1
	06D4 02D6	IF IZ < (PATNUMZ + 1) THEN GOTO SLOOP: 'check for done
		SEARCH.END:

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Reagent Jet Printer
Pattern Entry/Modification

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Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.00

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0609 02D6 CLOSE #1: 'not found so close file and display me
ssage
06E0 02D6 RETURN
06E4 02D6
06E4 02E6 REM \$PAGE

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Reagent Jet Printer
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	06E4 02D6	FATSAVE:
	06E9 02D6	GOSUB ITEMBOXERASE: 'erase blue box around DIR
	06EF 02D6	IF ELNUMZ = 0 THEN GOTO FIRST: 'no elements in pattern
	06FE 02D6	OPEN "PATDIR.RJP" FOR INPUT AS #1
10	070F 02D6	INPUT #1,PATNUMZ
	0721 02E6	IF PATNUMZ < 80 THEN GOTO SAVE.FAT: 'directory full
		at 80 patterns
	0730 02D6	CLOSE #1
	0737 02D6	LOCATE 25,1:PRINT SPACE\$(39); 'erase bottom l
15	0754 02D6	LOCATE 25,1:PRINT "Directory is full (80 patterns max)"
	076E 02D6	GOSUB ANYKEY:GOTO FIRST
	0778 02D6	SAVE.PAT:
	077D 02D6	GOSUB GETNAME: 'prompt for and get pattern name
20	0783 02D6	GOSUB SEARCH
	0789 02D6	IF IZ > PATNUMZ THEN GOTO ADD.NEW.PATTERN
	079A 02D6	LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
	07BF 02D6	LOCATE 10,13-(LEN(NAMES)/2):PRINT NAMES;" already exist
25	07F4 02D6	s."; LOCATE 12,15:PRINT "Replace it?"
	080E 02D6	PATNUMZ = IZ
	0815 02D6	AS = ""
	081F 02D6	WHILE AS = ""
	082E 02D6	AS = INKEY\$
30	0838 02D6	WEND
	083B 02D6	IF AS = "Y" OR AS = "y" THEN GOTO SAVE.PATTERN
	0864 02D6	GOTO FIRST
35	0868 02D6	ADD.NEW.PATTERN:
	086D 02D6	KILL "PATDIR.OLD": 'delete old backup directory
	0874 02D6	NAME "PATDIR.RJP" AS "PATDIR.OLD": 'save old direc
		tory
	087E 02D6	OPEN "PATDIR.OLD" FOR INPUT AS #1
	088F 02D6	OPEN "PATDIR.RJP" FOR OUTPUT AS #2: 'set up new dir
40	08A1 02D6	INPUT #1,PATNUMZ: 'read number of dir entries
	08B3 02D6	PATNUMZ = PATNUMZ + 1: 'increase by 1
	08BC 02D6	WRITE #2,PATNUMZ: 'save in new directory
	08CD 02D6	FOR I=1 TO PATNUMZ - 1
	08E6 02DA	LINE INPUT #1,AS: 'read entry from old dir
45	08F3 02DA	PRINT #2,AS: 'write entry in new directory
	0903 02DA	NEXT I
	091E 02DA	PRINT #2,NAMES: 'write new entry to new directo
		ry
	092E 02DA	CLOSE #1:CLOSE #2: 'done with directory
50	093C 02DA	SAVE.PATTERN:
	0941 02DA	FILES = RIGHTS(STR\$(PATNUMZ),LEN(STR\$(PATNUMZ))-1) + "P
		AT.RJP"
	0965 02DA	OPEN FILES FOR OUTPUT AS #1: 'create new pattern dat
		a file
55	0977 02DA	WRITE #1,ELNUMZ: 'store number of elements
	0988 02DA	WRITE #1,GRID: 'store grid dimension
	0998 02DA	WRITE #1,REPEATZ: 'store repeat count
	09A9 02DA	WRITE #1,XOFF: 'store x axis offset for repeat

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
0989	02DA	WRITE #1,YOFF: 'store y axis offset for repeat
09C9	02DA	FOR IZ = 0 TO ELNUNT - 1
09D7	02DC	FOR JZ = 0 TO 5
09DB	02DC	WRITE #1,SENDATZ(IZ,JZ): 'write screen a
		rray to file
0A00	02DC	NEXT JZ
0A10	02DC	NEXT IZ
0A22	02DC	CLOSE #1: 'done with data file
0A29	02DC	OPEN "PATDEF.RIP" FOR OUTPUT AS #1
0A38	02DC	PRINT #1,FILES: 'save filename in defau
		lt file
0A46	02DC	PRINT #1,NAMES: 'save the directory naa
		e as well
0A5B	02DC	CLOSE #1
0A62	02DC	GOTO FIRST
0A66	02DC	REM \$PAGE

Reagent Jet Printer
Pattern Entry/Modification

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IBM Personal Computer BASIC Console V2.00

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5      Offset Data      Source Line
      0A60 02DC  PATDRAW:
      0A63 02DC      GOSUB ITEMBOIERASE
      0A71 02DC      LINE (1,1)-(318,189),0,BF: 'Erase graphics tablet
      0A96 02DC
10     0A96 02DC  NEXTEL:
      0A98 02DC      MENUNGM = 2
      0AA5 02DC      EDSUB SUBMENU
      0AAB 02DC
      0AAB 02DC      ON (TEM + 1) GOTO ALINE, RECT, SRECT, ACIRCLE, REDRAW, B
15     ACKUP
      0AC8 02DC      GOTO NEXTEL
      0AC8 02DC
      0ACB 02DC  BACKUP:
      0AD0 02DC      GOSUB ITEMBOIERASE
20     0AD6 02DC      GOTO FIRST
      0ADA 02DC
      0ADA 02DC  ALINE:
      0ADF 02DC      TEMP1 = 1
      0AE6 02DE      STARTMSG$ = "STARTING ENDPOINT"
      0AF0 02E2      ENDMMSG$ = "ENDING ENDPOINT "
25     0AFA 02E6      GOTO ENTERELEMENT
      0AFE 02E6
      0AFE 02E6  RECT:
      0B03 02E6      TEMP1 = 2
      0B0F 02E6      GOTO RECTMSG
30     0B0E 02E6
      0B0E 02E6  SRECT:
      0B13 02E6      TEMP1 = 3
      0B1A 02E6  RECTMSG:
      0B1F 02E6      STARTMSG$ = "STARTING CORNER"
35     0B29 02E6      ENDMMSG$ = "ENDING CORNER "
      0B33 02E6      GOTO ENTERELEMENT
      0B37 02E6
      0B37 02E6  ACIRCLE:
      0B3C 02E6      TEMP1 = 4
40     0B43 02E6      STARTMSG$ = "CENTER OF CIRCLE"
      0B4D 02E6      ENDMMSG$ = "POINT ON CIRCLE "
      0B57 02E6
      0B57 02E6  ENTERELEMENT:
      0B5C 02E6      GOSUB ITEMBOIERASE
45     0B62 02E6      FLAG1=0
      0B69 02EB      LOCATE 25,1:PRINT SPACES(39);
      0B86 02EB      LOCATE 25,1:PRINT STARTMSG$;
      0BA0 02EB      GOSUB DISPCURSOR
      0BA6 02EB  FINDSTART:
50     0BA8 02EB      GOSUB MOUSEACT
      0BB1 02EB      IF A$ = CHR$(27) THEN GOTO A$ORT
      0BC8 02EB      IF A$ = CHR$(13) THEN GOTO SETSTART
      0BCF 02EB      GOSUB CURSORMOVE
      0BE5 02EB      GOTO FINDSTART
55     0BEE 02EB  A$ORT:
      0BED 02EB      GOSUB PLACECURSOR
      0BF3 02EB      GOTO NEXTEL
      0BF7 02EB

```

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Reagent Jet Printer
Pattern Entry/Modification

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

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08F7 02EB SETSTART:
08FC 02EB LOCATE 25,1:PRINT ENCMSG$:
0C16 02EB FLAG1 = TEMP1:11Z = 11Z:Y1Z = YZ
0C28 02EC IF FLAG1 = 4 THEN PSET (11Z+4,Y1Z+4)
0C35 02EC FINDEND:
0C5A 02EC GOSUB MOUSEACT
0C60 02EC IF A$ = CHR$(27) THEN GOTO CANCELEL
0C77 02EC IF A$ = CHR$(13) THEN GOTO SAVEEL
0C8E 02EC GOSUB CURSORMOVE
0C94 02EC GOTO FINDEND
0C97 02EC CANCELEL:
0C9C 02EC GOSUB PLACECURSOR
0CA2 02EC ON FLAG1 GOSUB ER1, ER2, ER3, ER4
0CB3 02EC FLAG1 = 0
0CB8 02EC GOTO NEXTEL
0CBE 02EC SAVEEL:
0CC3 02EC GOSUB PLACECURSOR
0CC9 02EC IF FLAG1 = 4 THEN CIRCLE (11Z+4,Y1Z+4),SQR((11Z-11Z)^2+(
35 YZ-Y1Z)^2),,,,1
0D32 02EC GOSUB CORRECT
0D38 02EC IF A$="N" THEN GOTO REDRAW
0D4B 02EC STOREEL:
0D50 02EC SCNDATZ(ELNUMZ,0) = FLAG1
0D6A 02EC SCNDATZ(ELNUMZ,1) = 11Z
0D85 02EC SCNDATZ(ELNUMZ,2) = Y1Z
0DA0 02EC SCNDATZ(ELNUMZ,3) = 1Z
0DB8 02EC SCNDATZ(ELNUMZ,4) = YZ
0DD6 02EC SCNDATZ(ELNUMZ,5) = 0
0DEF 02EC ELNUMZ = ELNUMZ + 1
0DFB 02EC FLAG1 = 0
0DFF 02EC GOTO NEXTEL
0E03 02EC REM $PAGE

```

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	0E03 02EC	REDRAW:
	0E08 02EC	GOSUB ITEMBOXERASE
	0E0E 02EC	LINE(1,1)-(312,169),0,BF
	0E33 02EC	IF ELNUM% = 0 THEN GOTO NEXTEL
10	0E42 02EC	
	0E42 02EC	FOR I=0 TO ELNUM%-1
	0E58 02F0	ON SCNDAT%(I,0) GOSUB RD1, RD2, RD3, RD4
	0E81 02F0	NEXT I
	0E9C 02F0	GOTO NEXTEL
15	0EA0 02F0	
	0EA0 02F0	***** Sub-routines called by main module *****
	0EA0 02F0	
	0EA0 02F0	SUBMENU:
	0EA5 02F0	
20	0EA5 02F0	LOCATE 25,1:PRINT SPACE\$(391):
	0EC2 02F0	ON MENUNUM GOSUB MENU1, MENU2
	0ED1 02F0	
	0ED1 02F0	FOR I=0 TO 6
	0ED8 02F0	READ MENU\$(I)
25	0EF2 02F0	LOCATE 25,(I+6)+2:PRINT MENU\$(I):
	0F28 02F0	NEXT I
	0F46 02F0	
	0F46 02F0	READ MAXITEM
	0F4D 02F4	ITEM = 0
30	0F57 02F4	
	0F57 02F4	NEXTITEM:
	0F5C 02F4	GOSUB NEXTITEMBOX
	0F62 02F4	
	0F62 02F4	NEXTITEM:
35	0F67 02F4	GOSUB ITEMSEARCH
	0F6D 02F4	IF AS = CHR\$(113) THEN RETURN: ITEM has correct value
	0F84 02F4	IF LEN(AS) < 2 THEN BEEP:GOTO NEXTITEM
	0F9A 02F4	IF ASC(MID\$(AS,2,1)) = 75 THEN GOTO LEFTAR
	0FB6 02F4	IF ASC(MID\$(AS,2,1)) = 77 THEN GOTO RIGHTAR
40	0FD2 02F4	BEEP:GOTO NEXTITEM
	0FD9 02F4	
	0FD9 02F4	LEFTAR:
	0FDE 02F4	IF ITEM = 0 THEN GOTO NEXTITEM
	0FEE 02F4	GOSUB ITEMBOXERASE
45	0FF4 02F4	ITEM = ITEM - 1
	1003 02F4	GOTO NEXTITEM
	1007 02F4	
	1007 02F4	RIGHTAR:
	100C 02F4	IF ITEM = MAXITEM THEN GOTO NEXTITEM
	101F 02F4	GOSUB ITEMBOXERASE
50	1025 02F4	ITEM = ITEM + 1
	1034 02F4	GOTO NEXTITEM
	1038 02F4	
	1038 02F4	MENU1:
	103D 02F4	RESTORE MN1
55	1044 02F4	RETURN
	1048 02F4	
	1048 02F4	MENU2:
	104D 02F4	RESTORE MN2

Reagent Jet Printer
Pattern Entry/Modification

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      1054 02F4      RETURN
      1058 02F4
      1058 02F4      ITEMSEARCH:
      1050 02F4      AS = INKEY$: IF AS <> "" THEN RETURN
      107A 02F4      GOTO ITEMSEARCH
10     107D 02F4      RETURN
      1081 02F4
      1081 02F4      NEWITEMGDI:
      1086 02F4      IX = (ITEM+48) + 7
      109C 02F8      IY = (ITEM+48) + 8 + LEN(MENU$(ITEM))+8
15     10D9 02FC      LINE (IX,191)-(IY,199),1,8
      1101 02FC      RETURN
      1105 02FC
      1105 02FC      ITEMDELETE:
      110A 02FC      LINE (IX,191)-(IY,199),0,8
20     1131 02FC      RETURN
      1135 02FC
      1135 02FC      PLACECURSOR:
      113A 02FC      PUT (IX+1,IY+1),CURSORZ
      1157 02FC      RETURN
25     1158 02FC
      1158 02FC      MOUSEACT:
      1160 02FC      GOSUB ANYKEY
      1166 02FC      DX = 0 : DY = 0
      1174 0300      IF AS = CHR$(0) + CHR$(72) THEN DY = -1: RETURN
30     119D 0300      IF AS = CHR$(0) + CHR$(60) THEN DY = 1: RETURN
      11C6 0300      IF AS = CHR$(0) + CHR$(77) THEN DX = 1: RETURN
      11EF 0300      IF AS = CHR$(0) + CHR$(75) THEN DX = -1: RETURN
      1218 0300      IF AS = "8" THEN DY = -20: RETURN
      1232 0300      IF AS = "2" THEN DY = 20: RETURN
35     124C 0300      IF AS = "4" THEN DX = -20: RETURN
      1266 0300      IF AS = "6" THEN DX = 20: RETURN
      1280 0300      IF AS = CHR$(27) THEN RETURN
      1297 0300      IF AS = CHR$(13) THEN RETURN
      12AE 0300      GOTO MOUSEACT
40     1282 0300
      1282 0300      CURSORMOVE:
      1287 0300      GOSUB PLACECURSOR
      128D 0300      ON FLAGZ GOSUB ER1, ER2, ER3, ER4
      12CE 0300      IX = IX + DX : IY = IY + DY
45     12EA 0300      IF IX < 0 THEN IX = 0
      12F8 0300      IF IY > 311 THEN IY = 311
      1308 0300      IF IY < 0 THEN IY = 0
      131D 0300      IF IY > 182 THEN IY = 182
      1330 0300      ON FLAGZ GOSUB DR1, DR2, DR3, DR4
50     1341 0300      GOSUB DISPCURSOR
      1347 0300      RETURN
      1348 0300
      1348 0300      CORRECT:
      1350 0300      LOCATE 25,1:PRINT SPACE$(39);
65     136D 0300      LOCATE 25,1:PRINT "IS THIS CORRECT? (Y or N) ";
      1387 0300      CORLOOP:
      138C 0300      GOSUB ANYKEY
      1392 0300      IF AS = "y" OR AS = "Y" THEN AS = "Y": GOTO CORRECT

```

Reagent Jet Printer
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	13C5 0300	IF A\$ = "n" OR A\$ = "N" THEN A\$ = "N":GOTO COREXIT
	13FB 0300	GOTO CORLOOP
	13FB 0300	COREXIT:
	1400 0300	LOCATE 25,1:PRINT SPACE\$(39);
	1410 0300	RETURN
10	1421 0300	
	1421 0300	DISPCURSOR:
	1426 0300	GOSUB PLACECURSOR
	142C 0300	LOCATE 25,27:PRINT USING "+0.000";XZ # GRID;
	1456 0300	PRINT " ";
15	1463 0300	PRINT USING "+0.000";YZ # GRID;
	1480 0300	RETURN
	1484 0300	
	1484 0300	
	1484 0300	RD1:
20	1489 0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCNDATZ(I,4)+4)
	1522 0300	RETURN
	1526 0300	
	1526 0300	RD2:
25	1528 0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCNDATZ(I,4)+4),,B
	15C4 0300	RETURN
	15C8 0300	
	15C8 0300	RD3:
30	15C0 0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCNDATZ(I,4)+4),,BF
	1667 0300	RETURN
	1668 0300	
	1668 0300	RD4:
35	1670 0300	RADIUSZ = SQR((SCNDATZ(I,3)-SCNDATZ(I,1))^2 + (SCNDATZ(I,4)-SCNDATZ(I,2))^2)
	16FF 0302	CIRCLE (SCNDATZ(I,1)+4,SCNDATZ(I,2)+4),RADIUSZ,,,1
	1750 0302	RETURN
	1761 0302	
40	1761 0302	DR1:
	1766 0302	LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4)
	17AF 0302	RETURN
	17B3 0302	
	17B3 0302	DR2:
45	17B8 0302	LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4),,B
	1801 0302	RETURN
	1805 0302	
	1805 0302	DR3:
	180A 0302	LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4),,BF
50	1854 0302	RETURN
	1858 0302	
	1858 0302	DR4:
	185D 0302	RETURN
	1861 0302	
55	1861 0302	ER1:
	1866 0302	LINE (XIZ+4,YIZ+4)-(XZ+4,YZ+4),0
	18AF 0302	RETURN
	18B3 0302	

Reagent Jet Printer
Pattern Entry/Modification

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

```

1883 0302 ER2:
1888 0302     LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4),0,5
1901 0302     RETURN
1905 0302
1905 0302 ER3:
190A 0302     LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4),0,8F
1954 0302     RETURN
1958 0302
1959 0302 ER4:
195D 0302     RETURN
1961 0302
1961 0302 ANYKEY:
1966 0302     AS = ""
1970 0302     WHILE AS = ""
1977 0302         AS = INKEY$
1989 0302     WEND
198C 0302     RETURN
1990 0302
1990 0302 GETNAME:    'prompt for and get filename
1995 0302     LOCATE 25,1:PRINT SPACE$(39);
1998 0302     LOCATE 25,38:PRINT "<<";    'boundry chevron
19CC 0302     LOCATE 25,1:PRINT "Enter Pattern Name ";
19E6 0302     LINE INPUT; "",NAME$
19F4 0302     RETURN
19FB 0302
19FB 0302 ' Data fields used by this module
19FB 0302
19FB 0302 MN1:
19FD 0302     DATA "DIR","LOAD","SAVE","DRAW","REPT","EXIT","",5
19FF 0302
19FF 0302 MN2:
1A04 0302     DATA "LINE","RECT","ERECT","CIRCL","REDRW","MAIN","",5
1A06 0302
1A06 0302 INSTRUCL:
1A08 0302     DATA 8,16,"USE ARROWS"
1A0D 0302     DATA 10,9,"TO SELECT FROM THE MENU"
1A0F 0302     DATA 14,12,"USE THE ENTER KEY"
1A11 0302     DATA 16,10,"TO ACTIVATE SELECTION"
1A13 0302
1A13 0302 END SUB
1A1A 0302
21AF 0302

```

50426 Bytes Available

43373 Bytes Free

0 Warning Error(s)

0 Severe Error(s)

Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 1
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08:38:16

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
5	0030 0006	REM \$TITLE: 'Reagent Jet Printer' \$SUBTITLE: 'Burr-Brown PCI-20000 custom driver'	
	0030 0006	'MODULE - "PCI" Driver for the PCI-20000 I/O and PULSE cards	
	0030 0006	'	
10	0030 0006	'AUTHOR - M. S. Fairchild of Computing Architects Inc.	
	0030 0006	113 Fairfield Way	
	0030 0006	Bloomington, IL 60108	
	0030 0006	312/980-6777	
	0030 0006	'	
15	0030 0006	'COPYRIGHT (C) 1985 ABBOTT LABORATORIES	
	0030 0006	'	
	0030 0006	'REVISION - 1.2 12-16-85 MSF Add digital I/O initialization, and output routine	
	0030 0006	'	
20	0030 0006	' - 1.1 12-10-85 MSF Move counter module to position 2	
	0030 0006	'	
	0030 0006	' - 1.0 11-22-85 MSF Creation of initial code	
	0030 0006	'	
	0030 0006	'SYSTEM - This code can only be compiled by the BASCOM V2	
25	0030 0006	COMPILER, it will not run under the INTERPRETER!!	
	0030 0006	'	
	0030 0006	'DESCRIPTION:	
	0030 0006	The PCI module is a group of routines used to access	
30	0030 0006	the BURR-Brown PCI-20000 board. The supplied software causes	
	0030 0006	the Wordstar2000 software to malfunction and will not provide	
	0030 0006	explicit on, off functions for the counters. Custom drivers	
35	0030 0006	will be used to provide all of the desired functions.	
	0030 0006	'	
	0030 0006	'	
	0030 0006	Address Register	
40	0030 0006	&HC0000 Carrier I.D. / module present (R)	
	0030 0006	&HC0040 Module interrupt status (R)	
	0030 0006	&HC0060 Digital I/O port 0 (R/W)	
	0030 0006	&HC0081 Digital I/O port 1 (R/W)	
	0030 0006	&HC0082 Buffer direction and enable (R/W)	
45	0030 0006	&HC0083 Control for ports 0 and 1 (W)	
	0030 0006	&HC00C0 Digital I/O port 2 (R/W)	
	0030 0006	&HC00C1 Digital I/O port 3 (R/W)	
	0030 0006	&HC00C3 Control for ports 2 and 3 (W)	
	0030 0006	'	
50	0030 0006	&HC0200 Read module I.D. (1110 1010)	
	0030 0006	&HC0204 Rate generator low-order 16 bits (O)	
	0030 0006	&HC0205 Rate generator high-order 16 bits (1)	
	0030 0006	&HC0206 Counter 3 count register (2)	
	0030 0006	&HC0207 Rate generator/counter 3 control	
55	0030 0006	&HC0208 Counter 0 count register (O)	
	0030 0006	&HC0209 Counter 1 count register (1)	
	0030 0006	&HC020A Counter 2 count register (2)	
	0030 0006	&HC020B Counter 0 - 2 control	
	0030 0006	&HC020C Counter gate control (1 enables, 0 disa	

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Reagent Jet Printer
Burr-Brown FCI-10000 custom driver

PAGE 2
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08:38:16

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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      0030 0006      bit      function
      0030 0006      0      Rate generator gate
      0030 0006      1      Rate generator gate
      0030 0006      2      Counter 0 gate
      0030 0006      3      Counter 1 gate
      0030 0006      4      Counter 2 gate
      0030 0006      5      Counter 3 gate
      0030 0006      6      Not used
      0030 0006      7      Not used

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      0030 0006      DATA DICTIONARY
      0030 0006      COUNT - Divisor to 2Mhz rate to give desired frequenc
      0030 0006      y or time
      0030 0006      COUNTHZ - High order 16 bits of a 32 bit divisor
      0030 0006      COUNTLZ - Low order 16 bits of a 32 bit divisor
      0030 0006      LSBZ - Lower 8 bits of a 16 bit divisor
      0030 0006      MSBZ - Upper 8 bits of a 16 bit divisor

```

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```

      0030 0006      Main line code
      0030 0006      The main line code is never executed. It's sole purpose
      0030 0006      it to
      0030 0006      declare shared the variables that will be used in the subrou
      0030 0006      tines
      0030 0006      so that they will all be defined and hold their values.

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      0030 0006      MAIN:
      0030 0006      DIM SHARED COUNT,COUNTHZ,COUNTLZ,LSBZ,MSBZ

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```

      0030 0006      MAINLOOP:
      0030 0006      GOTO MAINLOOP
      004C C012
      004C C012      REM $PAGE

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Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 3
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08:38:16

Offset Data Source Line IEN Personal Computer BASIC Compiler V2.00

```

5      004C 0012 'SUBROUTINE - PCI.INIT
      004C 0012 '
      004C 0012 'DESCRIPTION:
      004C 0012 '   The PCI.INIT subroutine initializes the PCI hardware.
10     004C 0012 '
      004C 0012 'END PCI.INIT STATIC
      0053 0012
      0053 0012 DEF SEG = &H0000: 'Point segment to PCI-20000 board
      005A 0012
      005A 0012 POKE &H020C,&H00: 'Disable all software enabled counter
15
      0063 0012
      0063 0012 ' Configure rate generator to 2 Khz
      0063 0012
      0063 0012 POKE &H0207,&H34: 'Set low rate counter to mode 2
20     006D 0012 POKE &H0207,&H74: 'Set high rate counter to mode 2
      0077 0012 POKE &H0204,&H02: 'Load low rate counter with 16 bits o
      0081 0012 f 2
      0081 0012 POKE &H0204,&H00
25     008A 0012 POKE &H0205,&H02: 'Load high rate counter with 16 bits
      0094 0012 of 2
      0094 0012 POKE &H0205,&H00
      009D 0012 POKE &H020C,&H03: 'Enable rate counters
      00A7 0012
      00A7 0012 ' Configure dot rate counters (default to 5 Khz)
30     00A7 0012
      00A7 0012 POKE &H0209,&H34: 'Set low dot counter (0) to mode 2
      00B1 0012 POKE &H020B,&H74: 'Set high dot counter (1) to mode 2
      00B8 0012 POKE &H020E,&H04: 'Load low rate counter with 16 bits o
35
      00C5 0012 f 4
      00C5 0012 POKE &H0209,&H00
      00CE 0012 POKE &H0209,&H64: 'Load high rate counter with 16 bits
      00D8 0012 of 100
      00D8 0012 POKE &H0209,&H00
40     00E1 0012
      00E1 0012 ' Configure dot pulse with one shot (default to 13 usec)
      00E1 0012
      00E1 0012 POKE &H0203,&H02: 'Set dot pulse with oneshot (2) to no
45     00EB 0012 de 1
      00EB 0012 POKE &H020A,&H1A: 'Load oneshot with 16 bits of 26
      00F5 0012 POKE &H020A,&H00
      00FE 0012
      00FE 0012 ' Configure shifted strobe pulse one shot (default to .5 usec)
      00FE 0012
      00FE 0012 POKE &H0207,&H82: 'Set shifted strobe onshot (3) to mod
50
      0108 0012 e 1
      0108 0012 POKE &H0206,&H01: 'Load oneshot with 16 bits of 1
      0112 0012 POKE &H0206,&H00
      0118 0012
      0118 0012 ' Configure port 0 to output and port 1 to input
55     0118 0012
      0118 0012 POKE &H00B3,&H82: ' Set up I/O chip
      0125 0012 POKE &H00B2,&H34: ' Set up direction and enable buffers
      012F 0012 POKE &H00B0,&H00: ' Dissable print head

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Reagent Jet Printer
Burr-Brown PDI-25000 custom driver

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08:38:16

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Offset  Data  Source Line  IBM Personal Computer BASIC Compiler V2.00

0138  0012      END SUB
013F  0012
20  013F  0012  REM $PAGEIF:12
013F  0012  'SUBROUTINE - DOT.ON
013F  0012  '
013F  0012  'DESCRIPTION:
013F  0012  ' The DOT.ON subroutine enables the dot frequency counter
25  013F  0012  '
013F  0012  SUB DOT.ON STATIC
013F  0012
0146  0012      POKE &H020C,&H0F: 'Enable dot counters and rate generat
30  0146  0012  or
0150  0012
0150  0012      END SUB
0157  0012
0157  0012  REM $PAGEIF:12
35  0157  0012  'SUBROUTINE - DOT.OFF
0157  0012  '
0157  0012  'DESCRIPTION:
0157  0012  ' The DOT.OFF subroutine disables the dot counters
40  0157  0012  SUB DOT.OFF STATIC
0157  0012
015E  0012      POKE &H020C,&H03: 'Disable dot counters and enable rate
015E  0012  generator
45  0168  0012      END SUB
0168  0012
016F  0012  REM $PAGEIF:49
016F  0012

```

Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 5
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08:38:16

```

5      Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

      016F 0012 'SUBROUTINE - SET.DOT.RATE
      016F 0012 '
10     016F 0012 'DESCRIPTION:
      016F 0012 ' The SET.DOT.RATE subroutine loads the dot rate counters
      016F 0012 ' with the desired dot frequency. Allowed range is 10,000 to 1
      016F 0012 ' Hz.
      016F 0012 ' The FREQ parameter is a real number in Hz.
15     016F 0012 '
      016F 0012 SUB SET.DOT.RATE(FREQ) STATIC
      0176 0012 ' Limit frequency to in range
      0176 0012 '
      0176 0012 IF FREQ < 1 THEN FREQ = 1
20     018F 0012 IF FREQ > 10000 THEN FREQ = 10000
      01A8 0012 '
      01A8 0012 ' Convert to count and check for 16 bit count or 32 bit count
      01A8 0012 '
      01A8 0012 COUNT = 2E6 / FREQ
25     01B8 0012 IF COUNT < 65536! THEN GOTO DIVIDE16 ELSE GOTO DIVIDE32
      01CF 0012 '
      01CF 0012 ' Process count of 32 bits
      01CF 0012 '
30     01CF 0012 DIVIDE32:
      01D0 0012 COUNTL = INT((COUNT/32768!) + 1): 'Stage lower count
      01F0 0012 COUNTH = INT(COUNT/COUNTL): 'Form upper count
      0208 0012 GOTO SET.COUNT
      020F 0012 '
35     020F 0012 ' Process count of 16 bits
      020F 0012 '
      020F 0012 DIVIDE16:
      0214 0012 COUNTL = 2
      0218 0012 COUNTH = INT(COUNT/2)
40     0232 0012 GOTO SET.COUNT
      0236 0012 '
      0236 0012 ' Send the derived counts out to the counters
      0236 0012 '
      0236 0012 SET.COUNT:
45     0237 0012 LSB = COUNTL MOD 256: ' Send out low 16 bits
      0248 0012 MSB = INT(COUNTL / 256)
      0263 0012 POKE &H0208,LSB
      0273 0012 POKE &H0208,MSB
      0283 0012 '
50     0283 0012 LSB = COUNTH MOD 256: ' Send out high 16 bits
      0291 0012 MSB = INT(COUNTH / 256)
      02AC 0012 POKE &H0209,LSB
      02BC 0012 POKE &H0209,MSB
      02CC 0012 '
55     02CC 0012 END SUB
      02D3 0012 '
      02D3 0012 REM $PAGEIF:27

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Reagent Jet Printer
Burr-Brown FCI-20000 custom driver

PAGE 6
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08:38:16

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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02D3 0012 'SUBROUTINE - SET.DOT.WIDTH
02D3 0012 '
02D3 0012 'DESCRIPTION:
02D3 0012 ' The SET.DOT.WIDTH subroutine loads the dot width one sh
ot
02D3 0012 ' with the desired dot pulse width. Allowed range is .5 to 16,0
00 usec.

25

02D3 0012 ' The dwidth parameter is a real number in usec.

02D3 0012 SUB SET.DOT.WIDTH(DWIDTH) STATIC

02DA 0012

02DA 0012 ' Limit width to in range

30

02DA 0012

IF DWIDTH < .5 THEN DWIDTH = .5

02DA 0012

IF DWIDTH > 16000 THEN DWIDTH = 16000

02F3 0012

030C 0012

' Convert to count

030C 0012

35

030C 0012

COUNT = DWIDTH / .5

031A 0012

031A 0012

' Send the derived count out to the counter

031A 0012

40

031A 0012

LSBZ = INT(COUNT MOD 256): ' Send out 16 bits

0331 0012

MSBZ = INT(COUNT / 256)

0348 0012

POKE &H020A,LSBZ

0358 0012

POKE &H020A,MSBZ

0368 0012

45

0368 0012

END SUB

036F 0012

036F 0012

REM \$PAGEIF:27

50

55

Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

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```

5      Offset  Data  Source Line      IBM Personal Computer BASIC Compiler V2.00

      036F 0012 'SUBROUTINE - SET.STROBE.DELAY
      036F 0012 '
      036F 0012 'DESCRIPTION:
10     036F 0012 ' The SET.STROBE.DELAY subroutine loads the strobe delay
      one shot
      036F 0012 ' with the desired strobe delay time. Allowed range is .5 to 16
      ,000 usec.
      036F 0012 ' The delay parameter is a real number in usec.
15     036F 0012
      036F 0012 SUB SET.STROBE.DELAY(DELAY) STATIC
      0376 0012
      0376 0012 ' Limit delay to in range
      0376 0012
20     0376 0012 IF DELAY < .5 THEN DELAY = .5
      036F 0012 IF DELAY > 16000 THEN DELAY = 16000
      03A8 0012
      03A8 0012 ' Convert to count
      03A8 0012
25     03A8 0012 COUNT = DELAY / .5
      03B6 0012
      03B6 0012 ' Send the derived count out to the counter
      03B6 0012
      03B6 0012 LSBZ = INT(COUNT MOD 256): ' Send out 16 bits
30     03C0 0012 MSBZ = INT(COUNT / 256)
      03E4 0012 POKE &H0206,LSBZ
      03F4 0012 POKE &H0206,MSBZ
      0404 0012
      0404 0012 END SUB
35     0408 0012
      0408 0012 REM $PAGEIF:16
      0408 0012 'SUBROUTINE - DIGITAL.OUT
      0408 0012 '
      0408 0012 'DESCRIPTION:
40     0408 0012 ' The DIGITAL.OUT subroutine sends the passed integer to
      the output
      0408 0012 ' port 0.
      0408 0012
      0408 0012 SUB DIGITAL.OUT(BYTEZ) STATIC
45     0412 0012
      0412 0012 ' Send the byte to the port
      0412 0012
      0412 0012 POKE &H0080,BYTEZ
      0423 0012
50     0423 0012 END SUB
      042A 0012
      057F 0012

```

50426 Bytes Available
48723 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

5

Reagent Jet Printer
Pattern Printing

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IBM Personal Computer BASIC Console V

Offset	Data	Source Line
0030	0006	PER STITLE:'Reagent Jet Printer' SSUBTITLE:'Pattern Printing' SLINESIZE:102
0030	0006	'MODULE - 'PATPRINT'
0030	0006	'AUTHOR - M. A. Enevold
0030	0006	'COPYRIGHT (C) 1985 ASPOTT LABORATORIES
0030	0006	'REVISION - 2.0 07-02-86 NAE Modified for MicroFab Printhead
0030	0006	- 1.1 03-07-85 NAE Added notes and final touches
0030	0006	1.0 02-03-86 NAE Creation of initial code
0030	0006	'SYSTEM - This code can only be compiled by the BASCOM
0030	0006	COMPILER, it will not run under the INTERPRETER!!
0030	0006	'DESCRIPTION:
0030	0006	The printing module displays a menu in 3 columns of 4 rows each. The first
0030	0006	column has data from the default reagent profile. The second column has
0030	0006	data from the default pattern file. The third column has standard printing
0030	0006	data. The four arrow keys allow different menu items to be highlighted and
0030	0006	the values can be changed with the + or - keys or by entering the new number
0030	0006	followed by Enter. P will cause the pattern to be printed, S will select the
0030	0006	notepad, and E will exit to the main program. On the notepad, any single line
0030	0006	entered here will be sent to the printer. A null line exits the notepad.
0030	0006	'DATA DICTIONARY
0030	0006	MENUZ Which menu item is highlighted (0-17)
0030	0006	DIFFZ Where to save menu highlight in response to arrow key
0030	0006	TYPEZ What key has been pressed during main scan
0030	0006	ELEMTZ Number of elements in current pattern
0030	0006	SCALATE(10,5) Array for storing elements in current pattern
0030	0006	REPEATZ Counter for repeat printing the pattern
0030	0006	CTLZ Counter for stepping through the pattern array during printing
0030	0006	RADIUSZ Radius of circle during printing
0030	0006	TX TZ Offsets for start row/column position
0030	0006	REPTZ REPTZ Repeat distances for repeat printing of patterns
0030	0006	STZ STZ Starting X and Y positions for solid rectangles
0030	0006	ETZ ETZ Ending X and Y positions for solid rectangles
0030	0006	IZ JZ Counters used for reading pattern files into the array
0030	0006	TEMPZ Register for misc. integers
0030	0006	NOTELINEZ Pointer to which line is active in the notepad
0030	0006	MENUZ(17,1) Array of strings used to display menu items
0030	0006	AS Single keystroke input destination
0030	0006	NOTES String entered in notepad and sent to printer
0030	0006	KEYSTUFF String entered from main scan and assigned to number of string field
0030	0006	REAGNAMEZ Name of default reagent
0030	0006	PATNAMEZ Name of default pattern
0030	0006	FILEZ Name of reagent data file and then pattern data file
0030	0006	NUMZ(11,4) Array of values used in displaying menu item numbers
0030	0006	TEMP Register for the temporary storage of real numbers
0030	0006	END PAGE

55

5 Reagent Jet Printer
Pattern Printing

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IBM Personal Computer BASIC Compiler V.

Offset	Data	Source Line
0030	0004	SUB PATPRINT STATIC
10 0047	0006	
0047	0006	DIM SCDAT\$(50,5),MENU\$(17,1),MENU(17,4)
0048	0462	
0048	0462	GOSUB INITIALIZE: 'read init. values and set screen
004E	0462	
004E	0462	WHILE TYPE1 < 1
15 0059	0464	
0059	0464	TYPE1 = 0
0060	0464	AS = ""
006A	0468	
006A	0468	WHILE AS = ""
0079	0468	AS = INKEY\$
20 0083	0468	WEND
0086	0468	
0086	0468	IF AS = "E" OR AS = "e" THEN TYPE1 = 1: 'exit sub
0082	0468	IF AS = "P" OR AS = "p" THEN TYPE1 = 2: 'print pattern
008E	0468	IF AS = "+" THEN TYPE1 = 3: 'increment variable
00F4	0468	IF AS = "-" THEN TYPE1 = 4: 'decrement variable
25 010A	0468	IF AS = CHR\$(65) + CHR\$(72) THEN TYPE1 = 5: 'up arrow key
012F	0468	IF AS = CHR\$(65) + CHR\$(80) THEN TYPE1 = 6: 'down arrow key
0154	0468	IF AS = CHR\$(65) + CHR\$(75) THEN TYPE1 = 7: 'left arrow key
0179	0468	IF AS = CHR\$(65) + CHR\$(77) THEN TYPE1 = 8: 'right arrow key
019E	0468	IF AS > CHR\$(47) AND AS < CHR\$(58) THEN TYPE1 = 9: 'number 0-9
30 01D6	0468	IF AS = "S" OR AS = "s" THEN TYPE1 = 10: 'enter scratchpad
0202	0468	
0202	0468	ON TYPE1 GOSUB T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
021F	0468	
021F	0468	WEND
0223	0468	TYPE1 = 0
35 022A	0468	
022A	0468	EXIT SUB
022E	0468	
022E	0468	'***** SUBROUTINES FOR THIS MODULE *****
022E	0468	T10: 'scratch pad
0233	0468	SCREEN 0,0,2,2:COLOR 7,0
40 0236	0468	LOCATE MOTELINE,1
0264	046A	MOTELCOP:
0269	046A	LINE INPUT NOTES
0277	046E	IF NOTES = "" THEN SCREEN 0,0,0,0:RETURN
029F	046E	LPRINT NOTES
02AC	046E	IF MOTELINE < 24 THEN MOTELINE = MOTELINE + 1
45 02C0	046E	GOTO MOTELCOP
02C3	046E	
02C3	046E	
02C3	046E	T1:
02C8	046E	RETURN: 'exit to print menu, no action
02CC	046E	
50 02CC	046E	T3:
02D1	046E	'process "+" key
033C	0470	IF MENU(MENU1,0) = MENU(MENU1,1) THEN MENU(MENU1,0) = MENU(MENU1,1):RETURN: 'check max value
0372	0470	MENU(MENU1,0) = MENU(MENU1,0) + MENU(MENU1,3): 'add increment
0388	0470	COLOR 0,7:GOSUB DISPMENU:RETURN: 'show new value
55 0388	0470	T4:
		'process "-" key

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Pattern Printing

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
0382	0470	IF MENU(MENUZ,0) <= MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,2):RETURN: 'check min value
03F2	0470	MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3): 'sub increment
042E	0470	COLOR 0,7:GOSUB DISPMENU:RETURN: 'show new value
0444	0470	
0444	0470	T5: 'process up arrow key
0449	0470	IF MENUZ MOD 6 = 0 THEN RETURN: 'in top row already
045E	0470	DIFFZ = -1:GOSUB NEWMENU:RETURN: 'move pointer up one
046F	0472	
046F	0472	T6: 'process down arrow key
0474	0472	IF MENUZ MOD 6 = 5 THEN RETURN: 'in bottom row already
0484	0472	DIFFZ = 1:GOSUB NEWMENU:RETURN: 'move pointer down one
0498	0472	
0498	0472	T7: 'process left arrow key
04A0	0472	IF INT(MENUZ / 6) = 0 THEN RETURN: 'in left column already
04C0	0472	DIFFZ = -6:GOSUB NEWMENU:RETURN: 'move pointer one left
04D1	0472	
04D1	0472	T8: 'process right arrow key
04D6	0472	IF INT(MENUZ / 6) = 2 THEN RETURN: 'in right column already
04F9	0472	DIFFZ = 6:GOSUB NEWMENU:RETURN: 'move pointer one right
050A	0472	
050A	0472	T9: 'input keys into KEYBUFs until (cr) is entered
050F	0472	LOCATE 25,30:COLOR 31,3:PRINT "ENTER NEW VALUE";:COLOR 15,0
0541	0472	KEYBUFs = AS
0548	0476	WHILE AS <> CHR\$(13)
055E	0476	LOCATE 25,47:PRINT SPACES(20);
0578	0476	LOCATE 25,47:PRINT KEYBUFs;
0595	0476	AS = ""
059F	0476	WHILE AS = ""
05AE	0476	AS = INKEYs
058B	0476	WEND
058B	0476	IF AS = CHR\$(18) AND LEN(KEYBUFs) > 0 THEN KEYBUFs = LEFT\$(KEYBUFs,LEN(KEYBUFs)-1)
05F0	0476	IF AS > CHR\$(31) THEN KEYBUFs = KEYBUFs + AS
061E	0476	WEND
0622	0476	TEMP = VAL(KEYBUFs) 'temp has value of keys input
0632	047A	
0632	047A	'round off temp according to step size in menu array
0632	047A	TEMP = INT(TEMP / (MENU(MENUZ,3) + .5) + MENU(MENUZ,3)
0648	047A	
0648	047A	'test TEMP for maximum and minimum values in menu array
0648	047A	IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
064A	047A	IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
06E7	047A	
06E7	047A	'insert new value into menu array and update screen
06E7	047A	MENU(MENUZ,0) = TEMP
0705	047A	LOCATE 25,30:PRINT SPACES(40);
0722	047A	COLOR 0,7:GOSUB DISPMENU
0734	047A	RETURN
0738	047A	
0738	047A	T2: 'set Burr-Brown board then print desired pattern
0750	047A	
0750	047A	DEFP:COLOR 15,0:LOCATE 25,1
075A	047A	PRINT "Set Potentiometers on Printer....then Press any Key";
0767	047A	AS = ""
0771	047A	WHILE AS = ""

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Pattern Printing

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
	0780 047A	AS = INKEYS
10	078A 047A	WEND
	078D 047A	LOCATE 25,1:PRINT SPACES(79);
	07AA 047A	
	07AA 047A	'enter drop parameters into burr-brown board
	07AA 047A	TEMP = MENU(0,0):CALL SET.DOT.RATE(TEMP)
	07D3 047A	TEMP = 3:CALL SET.DOT.WIDTH(TEMP)
15	07ED 047A	TEMP = MENU(2,0):CALL SET.STROBE.DELAY(TEMP)
	0619 047A	CALL DOT.ON
	0825 047A	
	0825 047A	TEMP1 = 4
	082C 047C	CALL DIGITAL.OUT(TEMP1)
	083C 047C	TEMP1 = 0: 'pulse RESET line
20	0843 047C	CALL DIGITAL.OUT(TEMP1)
	0853 047C	TEMP1 = 4
	085A 047C	CALL DIGITAL.OUT(TEMP1)
	086A 047C	
	086A 047C	J1 = CINT(MENU(1,0) * 255 / 150): 'set pulse amplitude by pulsing HIGHER signal J1 number of times
	0893 047E	FOR I1 = 1 TO J1
25	08A0 0480	TEMP1 = 6: 'set HIGHER true
	08A7 0480	CALL DIGITAL.OUT(TEMP1)
	08B7 0480	TEMP1 = 4: 'set HIGHER false
	08BE 0480	CALL DIGITAL.OUT(TEMP1)
	08CE 0480	NEXT I1
30	08E0 0482	
	08E0 0482	'establish COM1: and initialize plotter
	08E0 0482	OPEN "COM1:2400,N,8,2,CS 65535" AS #1
	08F2 0482	PRINT #1,"::UEE5,EFV1,n";
	0902 0482	
	0902 0482	'move nozzle offset and establish new origin
35	0902 0482	PRINT #1,"AO";
	0912 0482	
	0912 0482	'calculate row/column location, move there, and set new origin
	0912 0482	I1 = (MENU(12,0)-1) * (MENU(14,0) / 0.005)
	0954 0484	J1 = (MENU(13,0)-1) * (MENU(15,0) / 0.005)
	0996 0486	PRINT #1,I1;J1;"O";
40	09B4 0486	
	09B4 0486	'print the pattern using repeat count
	09B4 0486	REPT1 = MENU(8,0) / 0.005
	09B7 0488	REPT2 = MENU(9,0) / 0.005
	09FA 048A	
	09FA 048A	FOR REPEAT1 = 0 TO MENU(7,0)
45	0A1C 048C	
	0A1C 048C	'print the pattern
	0A1C 048C	FOR CT1 = 0 TO ELNOM1 - 1
	0A2A 0490	ON SCNDAT1(CT1,0) GOSUB PLINE, PRECT, FSRECT, PCIRCL
	0A4C 0492	NEXT CT1
	0A5E 0492	
50	0A5E 0492	PRINT #1,"A,0,0,";: 'return to origin
	0A6E 0492	PRINT #1,REPT1;REPT2;"O";: 'move to next pattern
	0A3C 0492	NEXT REPEAT1
	0AA1 0494	
	0AA1 0494	PRINT #1,"H";: 'return plotter to original HOME
55	0A81 0494	

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IBM Personal Computer BASIC Compiler V2

	Offset	Data	Source Line
	0A51	0494	CLOSE #1: 'disable coils
10	0A5B	0474	
	0A5B	0494	RETURN
	0A5C	0494	
	0A5C	0494	PLINE:
	0A5C	0474	PRINT #1,SENDATZ(CTL,2);SENDATZ(CTL,1);"0";
	0B03	0494	PRINT #1,SENDATZ(CTL,4);SENDATZ(CTL,3);"U";
15	0B45	0494	RETURN
	0B49	0494	
	0B49	0494	PRECT:
	0B4E	0494	PRINT #1,SENDATZ(CTL,2);SENDATZ(CTL,1);"0";
	0B50	0474	PRINT #1,SENDATZ(CTL,4);SENDATZ(CTL,3);
	0B5C	0494	PRINT #1,SENDATZ(CTL,4);SENDATZ(CTL,3);
20	0C08	0494	PRINT #1,SENDATZ(CTL,2);SENDATZ(CTL,3);
	0C14	0494	PRINT #1,SENDATZ(CTL,2);SENDATZ(CTL,1);"U";
	0C86	0494	RETURN
	0C8A	0494	
	0C8A	0494	PCIRCL:
	0C8F	0494	RADIUST = SQR((SENDATZ(CTL,3)-SENDATZ(CTL,1)) ² + (SENDATZ(CTL,4)-SENDATZ(CTL,2)) ²)
25	0D1A	0496	PRINT #1,"CC ";SENDATZ(CTL,2);SENDATZ(CTL,1);RADIUST;
	0D63	0496	RETURN
	0D67	0496	
	0D67	0496	PSRECT:
	0D6C	0496	SIZ = SENDATZ(CTL,4);EIZ = SENDATZ(CTL,2)
	0D70	0496	SYZ = SENDATZ(CTL,3);EYZ = SENDATZ(CTL,1)
30	0DD4	049E	IF EIZ <= SIZ THEN SIZ = SENDATZ(CTL,2);EIZ = SENDATZ(CTL,4)
	0E15	049E	IF EYZ <= SYZ THEN SYZ = SENDATZ(CTL,1);EYZ = SENDATZ(CTL,3)
	0E56	049E	
	0E56	049E	PRINT #1,SIZ;SYZ;"0";
	0E74	049E	
35	0E74	049E	IF EIZ - SIZ >= EYZ - SYZ THEN GOSUB STEPY ELSE GOSUB STEPX
	0E90	049E	
	0E90	049E	PRINT #1,"U";
	0EAD	049E	RETURN
	0EB1	049E	
	0EB1	049E	STEPY:
40	0EB6	049E	PRINT #1,EIZ;SYZ;
	0ECE	049E	SYZ = SYZ + 1
	0ED7	049E	IF SYZ > EYZ THEN RETURN
	0EE8	049E	PRINT #1,EIZ;SYZ;SIZ;SYZ;
	0F0E	049E	SYZ = SYZ + 1
	0F17	049E	IF SYZ > EYZ THEN RETURN
45	0F28	049E	PRINT #1,SIZ;SYZ;
	0F40	049E	GOTO STEPY
	0F44	049E	
	0F44	049E	STEPX:
	0F49	049E	PRINT #1,SIZ;EYZ;
	0F61	049E	SIZ = SIZ + 1
50	0F6A	049E	IF SIZ > EIZ THEN RETURN
	0F78	049E	PRINT #1,SIZ;EYZ;SIZ;SYZ;
	0FA1	049E	SIZ = SIZ + 1
	0FAA	049E	IF SIZ > EIZ THEN RETURN
	0FB8	049E	PRINT #1,SIZ;SYZ;
	0FD3	049E	GOTO STEPX
65			

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IBM Personal Computer EASIC Compiler V2

Offset	Data	Source Line
0FD7	049E	
10 0FD7	049E	NEWMENU: 'write old item in yellow, point to and highlight new item
0FDC	049E	COLOR 14,0:GOSUB DISPMENU
0FEE	049E	MENU1 = MENU1 + DIFF1
0FFA	049E	IF MENU1 = 10 THEN MENU1 = 9
100C	049E	IF MENU1 = 11 THEN MENU1 = 9
101E	049E	IF MENU1 > 15 THEN MENU1 = 15
15 1030	049E	COLOR 0,7:GOSUB DISPMENU:RETURN
1046	049E	
1046	049E	INITIALIZE:
104B	049E	'change to screen 0 and display messages
104B	049E	SCREEN 0,0,1:COLOR 7,0:CLS:LOCATE 10,17:PRINT "Loading selected Reagent and Pattern Data Files";
10BF	049E	LOCATE 12,33:PRINT "Please Wait..."
20 10A9	049E	
10A9	049E	'initialize notepad on screen 2
10A9	049E	SCREEN 0,0,2:CLS:COLOR 15
10CE	049E	PRINT "Digital Notepad - - All information typed here is sent to the printer"
10DB	049E	NOTELINES = 3
10E2	049E	
25 10E2	049E	'initialize menu arrays
10E2	047E	RESTORE AARDATA
10E9	049E	FOR I1=0 TO 17
10EF	049E	READ MENU(I1,0),MENU(I1,1):
111F	049E	READ MENU(I1,1),MENU(I1,2),MENU(I1,3),MENU(I1,4)
1180	049E	NEXT I1
30 1193	049E	
1193	049E	'get default reagent file and read values
1193	049E	
1193	049E	OPEN "REAGEF.RJP" FOR INPUT AS #1
11A4	049E	INPUT #1,FILES
11B6	04A2	INPUT #1,REAGNAME\$
35 11C8	04A6	CLOSE #1
11CF	04A6	
11CF	04A6	OPEN FILES FOR INPUT AS #1: 'get reagent data
11E0	04A6	INPUT #1,MENU(0,0): 'frequency
1200	04A6	INPUT #1,MENU(1,0): 'amplitude
40 1223	04A6	INPUT #1,MENU(2,0): 'stroke delay
1246	04A6	INPUT #1,MENU(3,0): 'pulse width
1269	04A6	INPUT #1,MENU(4,0): 'rise time
128C	04A6	INPUT #1,MENU(5,0): 'fall time
12B1	04A6	CLOSE #1
12B8	04A6	
45 12B8	04A6	'get default pattern file and read values
12B8	04A6	
12B8	04A6	OPEN "PATDEF.RJP" FOR INPUT AS #1
12C9	04A6	INPUT #1,FILES
12DB	04A6	INPUT #1,PATNAME\$
12ED	04AA	CLOSE #1
50 12F4	04AA	
12F4	04AA	OPEN FILES FOR INPUT AS #1: 'get pattern data
1305	04AA	INPUT #1,ELNUTZ
1317	04AA	INPUT #1,MENU(6,0): 'grid
132A	04AA	INPUT #1,MENU(7,0): 'repeat count
1350	04AA	INPUT #1,MENU(8,0): 'x offset
55		

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
		INPUT #1, MENU(9,0); 'offset
10	1360 04AA	FOR IZ = 0 TO ELEMNZ-1
	13A3 04AA	FOR JZ = 0 TO 5
	13B1 04AC	INPUT #1, SCNDATZ(IZ,JZ)
	13B7 04AC	NEXT JZ
	13D8 04AC	NEXT IZ
	13EB 04AC	CLOSE #1
15	13FD 04AC	
	1404 04AC	'set remaining parameters in menu array
	1404 04AC	
	1404 04AC	MENU(12,0) = 1: 'row 1
	1420 04AC	MENU(13,0) = 1: 'column 1
	143C 04AC	MENU(14,0) = 0: 'row spacing
20	145B 04AC	MENU(15,0) = 0: 'column spacing
	1474 04AC	'change active displayed screen to screen 0 to draw and display parameters
	1474 04AC	
	1474 04AC	SCREEN 0,0,0,1:CLS
25	1491 04AC	COLOR 13:LOCATE 1,32:PRINT "REAGENT PRINTING";
	1491 04AC	COLOR 9
	14B2 04AC	FOR I=2 TO 79
	14B9 04AC	LOCATE 3,1:PRINT CHR\$(196);LOCATE 5,1:PRINT CHR\$(205);LOCATE 18,1:PRINT CHR\$(196);
	14C3 04AC	NEXT I
	1523 04B0	FOR I=4 TO 17
30	153E 04B0	LOCATE 1,1:PRINT CHR\$(179);LOCATE 1,28:PRINT CHR\$(186);LOCATE 1,54:PRINT CHR\$(186);LOCATE 1,5
	1548 04B0	PRINT CHR\$(179);
	15C8 04B0	NEXT I
	15E6 04B0	RESTORE TABLE
	15ED 04B0	FOR I=1 TO 12
35	15F7 04B0	READ RZ,CZ,NZ:LOCATE RZ,CZ:PRINT CHR\$(NZ);
	162A 04B6	NEXT I
	1645 04B6	'display 16 menu choices in yellow
	1645 04B6	
	1645 04B6	COLOR 14,0
40	1651 04B6	FOR MENUZ = 0 TO 13
	1657 04B6	GOSUB DISPMENU
	165D 04B6	NEXT MENUZ
	166D 04B6	'set for first menu entry and highlight it
	166D 04B6	MENUZ = 0:COLOR 0,7
45	1680 04B6	GOSUB DISPMENU
	1686 04B6	
	1686 04B6	'print three headings and instructions
	1686 04B6	COLOR 10,0
	1692 04B6	LOCATE 4,14.5-LEN(REAGENT)/2:PRINT REAGENT;
	16C1 04B6	LOCATE 4,41-LEN(PATNAME)/2:PRINT PATNAME;
50	16F0 04B6	LOCATE 4,60:PRINT "PRINT LOCATION";
	170A 04B6	
	170A 04B6	COLOR 7:LOCATE 19,20:PRINT "Use ";COLOR 15:PRINT CHR\$(27);CHR\$(32);CHR\$(26);
	1754 04B6	PRINT CHR\$(32);CHR\$(24);CHR\$(32);CHR\$(25);COLOR 7:PRINT " to position highlighted cursor";
	1793 04B6	LOCATE 20,18:PRINT "Use ";COLOR 15:PRINT "+";COLOR 7:PRINT " or ";COLOR 15:PRINT "-";
	17E9 04B6	COLOR 7:PRINT " to scroll current value up or down";
55		

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Reagent Jet Printer
Pattern Printing

PAGE
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IBM Personal Computer BASIC Compiler V2.

Offset	Data	Source Line
25 17FD	0486	LOCATE 21,5:PRINT "Use ";:COLOR 15:PRINT "P";:COLOR 7:PRINT " to print pattern or ";
183F	0486	COLOR 15:PRINT "E";:COLOR 7:PRINT " to exit to print menu";
1867	0486	PRINT " or ";:COLOR 15:PRINT "S";:COLOR 7:PRINT " to use notepad";
189C	0486	
189C	0486	"set screen to view menu just created and exit
189C	0486	
30 189C	0486	SCREEN 0,0,0,0
18B1	0486	RETURN
18B5	0486	
18B5	0486	DISP#MENU:
18BA	0486	IF MENUZ = 10 OR MENUZ = 11 THEN RETURN
1E0E	0486	LOCATE (MENUZ MOD 61*2+7,(INT(MENUZ/61)*28+2)-2*INT(MENUZ/12)
35 193B	0486	PRINT MENU\$(MENUZ,0)
1956	0486	LOCATE (MENUZ MOD 61*2+7,MENU(MENUZ,4)
19E9	0486	PRINT USING MENU\$(MENUZ,1);MENU(MENUZ,0);
19E9	0486	RETURN
192F	0486	REM SPAGE

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Request: Jet Printer
10 Pattern Printing

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
198F	04B6	***** DATA USED BY THIS MODULE *****
198F	04B6	
15	198F	APRDATA:
19C4	04B6	DATA "Dot Frequency" Hz".100.000",10000.1,1,16
19C4	04B6	DATA "Amplitude" V ".1000",150.0,1,19
19C8	04B6	DATA "Stroke Delay" us".10.000.0",5999.5,.5,.5,16
19CA	04B6	DATA "Pulse Width" ".1000",999.0,1,19
19CC	04B6	DATA "Rise Time" ".1000",999.0,1,19
20	19CE	DATA "Fall Time" ".1000",999.0,1,19
19D0	04B6	DATA "Grid Size" in".0.000",.005,.005,.005,45
19D2	04B6	DATA "Repeat Count" ".100",99.0,1,17
19D4	04B6	DATA "X Axis Offset" in".0.000",2.0,.005,45
19D6	04B6	DATA "Y Axis Offset" in".0.000",2.0,.005,45
19D8	04B6	DATA "", "", 0,0,0,0
25	19DA	DATA "", "", 0,0,0,0
19DC	04B6	DATA "Row to Print" ".100",99,1,1,74
19DE	04B6	DATA "Column to Print" ".100",99,1,1,74
19E0	04B6	DATA "Row Spacing" in".0.000",3.0,.005,72
19E2	04B6	DATA "Column Spacing" in".0.000",3.0,.005,72
19E4	04B6	DATA "", "", 0,0,0,0
30	19E6	DATA "", "", 0,0,0,0
19E8	04B6	
19E8	04B6	TABE:
19ED	04B6	DATA 3,1,218
19EF	04B6	DATA 3,28,210
35	19F1	DATA 3,54,210
19F3	04B6	DATA 3,80,191
19F5	04B6	DATA 5,1,198
19F7	04B6	DATA 5,28,206
19F9	04B6	DATA 5,54,206
19FB	04B6	DATA 5,80,181
40	19FD	DATA 18,1,192
19FF	04B6	DATA 18,28,208
1A01	04B6	DATA 18,54,208
1A03	04B6	DATA 18,80,217
1A05	04B6	
1A05	04B6	EXT SUB
45	1A0C	
1A0C	04B6	
2049	04B6	

50426 Bytes Available
44716 Bytes Free

50
0 Warning Error(s)
0 Severe Error(s)

55

Reagent Jet Printer
Reagent Filing

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Offser: Jeta Source Line IEN Personal Computer BASIC Compiler V2.00

```

5      0030 0006  *MODULE - "REAFILE" File Handling for reagents
      0030 0006  *
      0030 0006  *AUTHOR - N. A. Enevold
10     0030 0006  *
      0030 0006  *COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006  *
      0030 0006  *REVISION - 1.1 03-07-86 NAE Added notes and description
      0030 0006  *          1.0 02-14-86 NAE Creation of initial code
15     0030 0006  *
      0030 0006  *SYSTEM - This code can only be compiled by the BASCOM
      0030 0006  *          COMPILER, it will not run under the INTERPRETER!!
      0030 0006  *
      0030 0006  *DESCRIPTION:
20     0030 0006  *          This module allow file handling for reagents. When inv
      0030 0006  *          oked, it displays
      0030 0006  *          the current contents of the reagent directory in 4 colu
      0030 0006  *          ans of 20 entries
      0030 0006  *          each. The reagent which is currently selected for prin
25     0030 0006  *          ting is marked by
      0030 0006  *          an asterisk to the left of the reagent name. After the
      0030 0006  *          directory is listed
      0030 0006  *          the user is presented with 5 menu choices. The left an
30     0030 0006  *          d right arrows are
      0030 0006  *          used to highlight menu items and the enter key is used
      0030 0006  *          to invoke action.
      0030 0006  *          The menu choices and their actions are:
      0030 0006  *
      0030 0006  *          DELETE - Remove a reagent file from the directo
35     0030 0006  *          ry
      0030 0006  *          COPY - Copy a reagent file to a new reagent n
      0030 0006  *          ame, saving the old reagent
      0030 0006  *          RENAME - Change the name of the reagent without
      0030 0006  *          changing the reagent itself
40     0030 0006  *          SELECT - Select a reagent for printing
      0030 0006  *          EXIT - Return to the main menu
      0030 0006  *
      0030 0006  *DATA DICTIONARY
      0030 0006  *          TYPEI Which type of valid key was pushed
45     0030 0006  *          MENUZ Which menu item is being pointer to (0-4)
      0030 0006  *          DIFFI Distance to move MENUZ at left or right arro
      0030 0006  *
      0030 0006  *          FLAGZ Error type 0-4
      0030 0006  *          POINTERI Position of REANAMES in directory list
50     0030 0006  *          REANUMZ Number of reagent names in directory
      0030 0006  *          list
      0030 0006  *          TEMPI Storage for integers during reagent copy
      0030 0006  *          AS Misc. input string
      0030 0006  *          FUNCTZ Printed at bottom of screen during prompt fo
55     0030 0006  *          r reagent name
      0030 0006  *          REANAMES Reagent name currently being worked on
      0030 0006  *          SELNAMEZ Reagent name currently selected for printing
      0030 0006  *          FILEF Filenase of reagent data file
      0030 0006  *          SFILES Filenase for source reagent data file used d

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5 Reagent Jet Printer PAGE 2
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 IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
0030	0006	uring COPY
0030	0006	FILES Filename for destination reagent data file u
0030	0006	ses during COPY
0030	0006	NEWNAME\$ New reagent name for COPY and RENAME
0030	0006	TEMP\$ Reagent names are held here as the directory
0030	0006	is being re-written
0030	0006	NEWFILES Destination filename used while copying reagent data files
0030	0006	MESSAGES\$ A message printed at the bottom of the screen
0030	0006	MENUS(4,1) Array of strings containing the short and long menu names
0030	0006	ERRMSG\$ Message printed when any error occurs
0030	0006	ERR\$ Appended to ERRMSG\$ to indicate nature of error
0030	0006	REM \$PAGE

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Offset	Data	Source Line
0030	0006	SUB REAGENT.FILE STATIC
0047	0006	60SUB INITIALIZE
0040	0006	TYPEZ = 0
0054	0008	WHILE TYPEZ < 3
005F	0008	AS = ""
0069	000C	WHILE AS = ""
0078	000C	AS = INKEY\$
0082	000C	WEND
0085	000C	IF AS = CHR\$(0) + CHR\$(75) THEN TYPEZ = 1:
00AA	000C	IF AS = CHR\$(0) + CHR\$(77) THEN TYPEZ = 2:
00CF	000C	IF AS = CHR\$(13) THEN TYPEZ = 3:
00E9	000C	'left arrow
00E9	000C	'right arrow
00E9	000C	'(cr) to execute selection
00F8	000C	ON TYPEZ 60SUB T1, T2, T3
00FC	000C	WEND
00FC	000C	EXIT SUB
0100	000C	REM \$PAGE

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Offset  Data      Source Line      IBM Personal Computer BASIC Compiler V2.00

0100  000C      ***** SUB-ROUTINES FOR THIS MODULE *****
0100  000C
0100  000C      T1:      'left arrow
0105  000C          TYPE1 = 0
010C  000C          IF MENU1 = 0 THEN RETURN
011B  000E          DIFF1 = -1
0122  0010          GOSUB REM.MENU
012B  0010          RETURN
012C  0010
012C  0010      T2:      'right arrow
0131  0010          TYPE2 = 0
013B  0010          IF MENU2 = 4 THEN RETURN
0147  0010          DIFF2 = 1
014E  0010          GOSUB REM.MENU
0154  0010          RETURN
015B  0010
015B  0010      T3:      '(cr) (execute selected menu item)
015D  0010          LOCATE 25,1:PRINT SPACES(79);
017A  0010          ON MENU3 + 1 GOSUB T2A, T3B, T3C, T3D, T3E
018F  0010          GOSUB REMJ.ON
0195  0010          RETURN
0199  0010
0199  0010      REM $PAGE

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Reagent Jet Printer
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Offset Data Source Line ISA Personal Computer BASIC Compiler V2.00

5
0199 0010 TJA: 'delete reagent
019E 0010 TYPEZ = 0
01A5 0010 FUNCT$ = "Delete"
01AF 0014 GOSUB GET.SOURCE
10 01B5 0014 IF LEN(REANAME$) = 0 THEN RETURN
01C7 0018 IF REANAME$ = SELNAME$ THEN FLAGZ = 4:GOSUB SHOW.ERROR:
RETURN
01E7 001E GOSUB SEARCH
01ED 001E IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
15 0209 0020 MESSAGE$ = "Deleting " + REANAME$ + " Please Wait..
0209 0020
0220 0024 GOSUB MESSAGE.ON
0226 0024
20 0226 0024 'rewrite directory deleting REANAME$ as indicat
ed by POINTERZ
0226 0024 KILL "READIR.OLD"
022D 0024 NAME "READIR.RJP" AS "READIR.OLD"
0237 0024 OPEN "READIR.OLD" FOR INPUT AS #1
25 0248 0024 OPEN "READIR.RJP" FOR OUTPUT AS #2
025A 0024 INPUT #1, REANUMZ
025A 0024 REANUMZ = REANUMZ - 1
026C 0026 WRITE #2,REANUMZ
0275 0026
30 0286 0026 IF REANUMZ = 0 THEN GOTO DIR.DONE
0286 0026 FOR IZ = 1 TO REANUMZ + 1
0295 0026 INPUT #1,REANAME$
02A4 0028 IF IZ <> POINTERZ THEN PRINT #2,REANAME$
02B6 0028 NEXT IZ
35 02D3 002A DIR.DONE:
02E5 002A CLOSE #1:CLOSE #2
02EA 002A
02FB 002A
40 02FB 002A 'remove data file
02FB 002A FILE$ = RIGHT$(STR$(POINTERZ),LEN(STR$(POINTERZ))-1) +
"REA.RJP"
031C 002E KILL FILE$
0323 002E
45 0323 002E 'rename remaining data files to maintain linked
list to directory
0323 002E WHILE (REANUMZ + 1) > POINTERZ
0333 002E SFILE$ = RIGHT$(STR$(POINTERZ+1),LEN(STR$(POINT
ERZ+1))-1) + "REA.RJP"
0359 0032 DFILE$ = RIGHT$(STR$(POINTERZ),LEN(STR$(POINTER
Z))-1) + "REA.RJP"
50 037D 0036 NAME SFILE$ AS DFILE$
0387 0036 POINTERZ = POINTERZ + 1
0390 0036 WEND
0393 0036
55 0393 0036 GOSUB MESSAGE.OFF
0399 0036 REANAME$ = SELNAME$
03A3 0036 GOSUB TJDA
03A9 0036 GOSUB DISP.DIR

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Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.00

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03AF 0036 RETURN
03B3 0036
03B3 0036 REM \$PAGE

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13% Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	03B3 0036	T32: 'copy reagent
	03B8 0036	TYPE% = 0
	03BF 0036	IF REANUM% = 80 THEN FLAG% = 3:GOSUB SHOW.ERROR:RETURN
	03D8 0036	FUNCT% = "Copy"
10	03E5 0036	GOSUB GET.SOURCE
	03EB 0036	IF LEN(REANAME%) = 0 THEN RETURN
	03FD 0036	GOSUB SEARCH
	0403 0036	IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
	041F 0036	
15	041F 0036	GOSUB GET.NEW.NAME
	0425 0036	IF LEN(NEWNAME%) = 0 THEN RETURN
	0437 003A	IF LEN(NEWNAME%) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
		ETURN
	0457 003A	
20	0457 003A	MESSAGE% = "Copying ' + REANAME% + ' to ' + NEWNAME% +
		' Please wait..'
	047C 003A	GOSUB MESSAGE.ON
	0482 003A	
	0482 003A	'add new name at end of directory
25	0482 003A	KILL "READIR.OLD"
	0489 003A	NAME "READIR.RJP" AS "READIR.OLD"
	0493 003A	OPEN "READIR.OLD" FOR INPUT AS #1
	04A4 003A	OPEN "READIR.RJP" FOR OUTPUT AS #2
	04B6 003A	
30	04B6 003A	INPUT #1, REANUM%
	04CB 003A	REANUM% = REANUM% + 1
	04D1 003A	WRITE #2, REANUM%
	04E2 003A	
	04E2 003A	FOR I% = 1 TO REANUM% - 1
35	04F1 003C	INPUT #1, TEMP%
	0503 0040	PRINT #2, TEMP%
	0513 0040	NEXT I%
	0525 0040	PRINT #2, NEWNAME%
	0535 0040	
40	0535 0040	CLOSE #1:CLOSE #2
	0543 0040	
	0543 0040	'create copy of data file
		FILES% = RIGHTS\$(STR\$(POINTER%)-1) +
		"REA.RJP"
45	0567 0040	NEWFILES% = RIGHTS\$(STR\$(REANUM%), LEN(STR\$(REANUM%))-1) +
		"REA.RJP"
	058B 0044	
	058B 0044	OPEN FILES% FOR INPUT AS #1
	059C 0044	OPEN NEWFILES% FOR OUTPUT AS #2
50	05AE 0044	
	05AE 0044	INPUT #1, TEMP
	05C0 004B	WRITE #2, TEMP: 'frequency
	05D0 004B	INPUT #1, TEMP
	05E2 004B	WRITE #2, TEMP: 'pulse width
55	05F2 004B	INPUT #1, TEMP
	0604 004B	WRITE #2, TEMP: 'strobe delay
	0614 004B	INPUT #1, TEMP
	0626 004B	WRITE #2, TEMP: 'nozzle
	0636 004B	

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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0636 0048 INPUT #1,TEMP#
0648 0048 PRINT #2,TEMP#; 'concentration
0658 0048 INPUT #1,TEMP#
066A 0048 PRINT #2,TEMP#; 'density
067A 0048 INPUT #1,TEMP#
068C 0048 PRINT #2,TEMP#; 'viscosity
069C 0048
069C 0048 CLOSE #1;CLOSE #2
06AA 0048
06AA 0048 GOSUB MESSAGE.GFF
06B0 0048 GOSUB DISP.DIR
06B6 0048 RETURN
06BA 0048
06BA 0048 REM $PAGE

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Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
06BA	0046	TTC: 'rename reagent	
06BF	0048	TYPE1 = 0	
06C5	0048	FUNCT\$ = "Rename"	
06D0	0048	GOSUB GET.SOURCE	
06D6	0048	IF LEN(REANAME\$) = 0 THEN RETURN	
06E3	0048	GOSUB SEARCH	
06EE	0048	IF POINTER1 = 0 THEN FLAG1 = 1:GOSUB SHOW.ERROR:RETURN	
070A	0048		
070A	0048	GOSUB GET.NEW.NAME	
0710	0048	IF LEN(NEWNAME\$) = 0 THEN RETURN	
0722	0048	IF LEN(NEWNAME\$) > 15 THEN FLAG2 = 2:GOSUB SHOW.ERROR:R	
		ETURN	
0742	0048	IF NEWNAME\$ = REANAME\$ THEN RETURN	
0755	0048	MESSAGE\$ = "Renaming " + REANAME\$ + " to " + NEWNAME\$ +	
		" Please wait..."	
077A	0048	GOSUB MESSAGE.ON	
0780	0048		
0780	0048	'renaming reagent name in directory	
0780	0048	KILL "READIR.OLD"	
0787	0048	NAME "READIR.RJP" AS "READIR.OLD"	
0791	0048	OPEN "READIR.OLD" FOR INPUT AS #1	
07A2	0048	OPEN "READIR.RJP" FOR OUTPUT AS #2	
07B4	0048		
07B4	0048	INPUT #1, REANUM1	
07C6	0048	WRITE #2, REANUM1	
07D7	0048		
07D7	0048	FOR I1 = 1 TO REANUM1	
07E4	004A	INPUT #1, TEMP1	
07F6	004A	IF I1 <> POINTER1 THEN PRINT #2, TEMP1	
0813	004A	IF I1 = POINTER1 THEN PRINT #2, NEWNAME\$	
0830	004A	NEXT I1	
0842	004A		
0842	004A	CLOSE #1:CLOSE #2	
0850	004A		
0850	004A	GOSUB MESSAGE.OFF	
0856	004A	IF REANAME\$ = SELNAME\$ THEN REANAME\$ = NEWNAME\$:GOSUB T	
		JDA	
0875	004A	GOSUB DISP.DIR	
087B	004A	RETURN	
087F	004A		
087F	004A	REM \$PAGE	

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Offset: Data Source Line IEN Personal Computer BASIC Compiler V2.00

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067F 004A TJE: 'select reagent for printing
0681 004A 'VFEI = 0
0683 004A FUNCTS = "Select"
0685 004A SCSUB GET.SOURCE
0687 004A IF LEN(REANAME$) = 0 THEN RETURN
0689 004A IF REANAMES = SELNAMES THEN RETURN
068B 004A SCSUB T3DA
068D 004A GOSUB DISP.DIR
068F 004A RETURN

```

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```

08D0 004A T3DA:
08D2 004A BCSUB SEARCH
08D4 004A IF POINTER2 = 0 THEN FLAG2 = 1:GOSUB SHOW.ERROR:RETURN
08D6 004A
08D8 004A MESSAGE$ = "Selecting " + REANAMES + " Please Wait.
08DA 004A

```

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090E 004A BCSUB MESSAGE.ON
0910 004A
0912 004A 'change entrys in reagent default file READE.F.R

```

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```

JP
0914 004A OPEN "READE.F.R" FOR OUTPUT AS #1
0916 004A FILES = RIGHTS(STR$(POINTER2),LEN(STR$(POINTER2))-1) +
"REA.RJP"

```

40

```

094A 004A
094C 004A PRINT #1,FILES
094E 004A PRINT #1,REANAMES
0950 004A
0952 004A CLOSE #1
0954 004A BCSUB MESSAGE.OFF
0956 004A RETURN

```

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0977 004A
0979 004A TJE: 'exit reagent filing
097B 004A RETURN

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0984 004A REN 1746E

```

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Reagent Jet Printer
Reagent Filing

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IBM Personal Computer BASIC Compiler V2.00

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5      Offset Data      Source Line
      0984 004A SEARCH:
      0989 004A          POINTERZ = 0
      0990 004A          OPEN "READIR.RJP" FOR INPUT AS #1
      09A1 004A          INPUT #1,REANUMZ: ' get number of reagents in direc
10      tory
      09B3 004A          IF REANUMZ = 0 THEN CLOSE #1:RETURN
      09C9 004A          TEMPS = ""
      09D3 004A          WHILE (POINTERZ < REANUMZ) AND (REANAME$ <> TEMPS)
      09FB 004A              LINE INPUT #1,TEMPS
      0A06 004A              POINTERZ = POINTERZ + 1
15      0A11 004A          WEND
      0A14 004A          IF REANAME$ <> TEMPS THEN POINTERZ = 0
      0A2A 004A          CLOSE #1
      0A31 004A          RETURN
20      0A35 004A GET.SOURCE:
      0A3A 004A          LOCATE 25,1:COLOR 15,0:PRINT "Enter Reagent Name to "FU
      0A6C 004A          NCT$ " "; LINE INPUT;"",REANAME$
25      0A7A 004A          LOCATE 25,1:PRINT SPACES(79);
      0A97 004A          RETURN
      0A9B 004A GET.NEW.NAME:
      0A9B 004A          LOCATE 25,1:COLOR 15,0:PRINT "Enter New Reagent Name ";
      0AA0 004A          LINE INPUT;"",NEWNAME$
30      0AC6 004A          LOCATE 25,1:PRINT SPACES(79);
      0AD4 004A          RETURN
      0AF1 004A DISP.DIR: 'display reagent directory in 4 columns of 20 r
      0AF5 004A          cws
35      0AFA 004A          'read selected reagent into SELNAME$
      0AFA 004A          OPEN "READIR.RJP" FOR INPUT AS #1
      0B0B 004A          INPUT #1,SELNAME$: 'read and discard data file nam
40      0B1D 004A          INPUT #1,SELNAME$: 'read and save reagent name
      0B2F 004A          CLOSE #1
      0B36 004A          OPEN "READIR.RJP" FOR INPUT AS #1
      0B47 004A          INPUT #1,REANUMZ: ' read number of reagents
45      0B5F 004A          MESSAGE$ = "Reading Reagent Directory Please Wait"
      0B6J 004A          GOSUB MESSAGE.ON
      0B69 004A          FLAGZ = 0
      0B70 004A          TEMPZ = REANUMZ - 1:IF REANUMZ < 80 THEN TEMPZ = REANUM
50      08BB 004C          I
      0897 004E          FOR IZ = 0 TO TEMPZ
      08CA 004E              LOCATE (IZ MOD 20)+1,(INT(IZ/20)+20)+1
      08DA 004E              PRINT SPACES(18);
      08EC 004E          NEXT IZ
55      08EC 004E          FOR IZ = 0 TO REANUMZ - 1
      08FA 0050              INPUT #1,REANAME$
      0C0C 0050              LOCATE (IZ MOD 20)+1,(INT(IZ/20)+20)+3
      0C3F 0050              PRINT REANAME$;
      0C4C 0050              IF REANAME$ = SELNAME$ THEN LOCATE (IZ MOD 20)+

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Offset Data Source Line IBM Personal Computer BASIC Compiler v2.00

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5      1,(INT((13/10)*20)+1):PRINT "+";
      0C9B 0050      NEXT I2
      0CB0 0050      CLOSE #1
      0CB7 0050      GOSUB MESSAGE.OFF
      0CB0 0050      RETURN
10     0CC1 0050      INITIALIZE:
      0CC6 0050          DIM MENU$(4,1)
      0CC7 0078      MENU$(0,0) = "Delete"
      0CDF 0078      MENU$(0,1) = "Remove a reagent file from the directory"
15     0CFA 0078      MENU$(1,0) = "Copy"
      0D15 0078      MENU$(1,1) = "Copy a reagent file to a new reagent name

      0D2E 0078      MENU$(2,0) = "Rename"
      0D4B 0078      MENU$(2,1) = "Rename a reagent file in the directory"
20     0D69 0078      MENU$(3,0) = "Select"
      0D84 0078      MENU$(3,1) = "Select a reagent file to be printed"
      0DA0 0078      MENU$(4,0) = "Exit"
      0D8B 0078      MENU$(4,1) = "Return to the main menu"
25     0DD7 0078      COLOR 9,0:CLS
      0DD7 0078      LOCATE 21,1
      0DEA 0078      FOR I2 = 1 TO 80
      0DF7 0078          PRINT "D";
      0DFE 0078      NEXT I2
30     0E1B 0078      FOR MENU2 = 0 TO 4
      0E1B 0078          GOSUB MENU.OFF
      0E21 0078      NEXT MENU2
      0E27 0078
35     0E37 0078      GOSUB DISP.DIR
      0E3D 0078      IF FLAG2 > 0 THEN GOSUB SHOW.ERROR
      0E4E 0078      MENU2 = 4
      0E55 0078      GOSUB MENU.ON
40     0E5B 0078      RETURN
      0E5B 0078
      0E5F 0078      MEN.MENU:
      0E5F 0078          GOSUB MENU.OFF
      0E64 0078          MENU2 = MENU2 + DIFF2
45     0E6A 0078          GOSUB MENU.ON
      0E76 0078          RETURN
      0E7C 0078
      0E80 0078      MENU.ON:
      0E80 0078          LOCATE 22,(MENU2*10)+18
50     0E85 0078          COLOR 0,7
      0E9C 0078          PRINT MENU$(MENU2,0);
      0EAB 0078          LOCATE 23,40-LEN(MENU$(MENU2,1))/2
      0EC6 0078          COLOR 7,0
      0EFA 0078          PRINT MENU$(MENU2,1);
55     0F06 0078          RETURN
      0F25 0078
      0F29 0078      MENU.OFF:
      0F29 0078          LOCATE 22,(MENU2*10)+18
      0F2E 0078

```

Reagent Jet Printer
Reagent Filing

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```

5      0F45 0078      COLGR 14,0
      0F51 0078      PRINT MENU$(MENUZ,0);
      0F6F 0078      LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
      0FA3 0078      PRINT SPACES(LEN(MENU$(MENUZ,1)));
10     0FC8 0078      RETURN
      0FCC 0078
      0FCC 0078      SHOW.ERROR:
      0FD1 0078      ON FLAG% GOSUB ER1, ER2, ER3, ER4
      0FE2 0078      ERRMSG$ = ERR$ + " Strike any key.."
15     0FF2 0080      LOCATE 24,40-LEN(ERRMSG$)/2
      1014 0080      COLOR 13,0
      1020 0080      PRINT ERRMSG$;
      1020 0080      AS = ""
      1037 0080      WHILE AS = ""
20     1046 0080          AS = INKEY$
      1050 0080      WEND
      1053 0080      GOSUB MESSAGE.OFF
      1059 0080      RETURN
      105D 0080
25     105D 0080      ER1:
      1062 0080          ERR$ = REANAME$ + " Not Found in the Directory"
      1072 0080          RETURN
      1076 0080
      1076 0080      ER2:
30     107B 0080          ERR$ = "Reagent Name is too Long (15 characters max.)"
      1085 0080          RETURN
      1089 0080
      1089 0080      ER3:
      108E 0080          ERR$ = "Directory is full (80 reagents max.)"
35     1098 0080          RETURN
      109C 0080
      109C 0080      ER4:
      10A1 0080          ERR$ = "Cannot Modify SELECTd reagent Name"
      10AB 0080          RETURN
40     10AF 0080
      10AF 0080      MESSAGE.ON:
      10B4 0080          LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
      10EF 0080          GE$;
      10EF 0080          RETURN
45     10F3 0080
      10F3 0080
      10F3 0080      MESSAGE.OFF:
      10F8 0080          LOCATE 24,1:COLOR 15,0:PRINT SPACES(79);
      1121 0080          RETURN
50     1125 0080
      1125 0080      END SUB
      112C 0080
      16C9 0080

```

50426 Bytes Available
45718 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

Reagent Jet Printer
Pattern Filing

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	0030 0006	REM TITLE: 'Reagent Jet Printer' SSUBTITLE: 'Pattern Filing'
	0030 0006	'MODULE - 'PATFILE' File Handling for patterns
	0030 0006	'
	0030 0006	'AUTHOR - M. A. Enevold
	0030 0006	'
10	0030 0006	'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
	0030 0006	'
	0030 0006	'REVISION - 1.0 02-12-86 NAE Creation of initial code
	0030 0006	'
15	0030 0006	'SYSTEM - This code can only be compiled by the BASCOM
	0030 0006	COMPILER, it will not run under the INTERPRETER!!
	0030 0006	'
	0030 0006	'DESCRIPTION:
	0030 0006	' This module allow file handling for patterns. When inv
20	0030 0006	oked, it displays
	0030 0006	' the current contents of the pattern directory in 4 colu
	0030 0006	ms of 20 entries
	0030 0006	' each. The pattern which is currently selected for prin
	0030 0006	ting is marked by
25	0030 0006	' an asterisk to the left of the pattern name. After the
	0030 0006	directory is listed
	0030 0006	' the user is presented with 5 menu choices. The left an
	0030 0006	d right arrows are
	0030 0006	' used to highlight menu items and the enter key is used
30	0030 0006	to invoke action.
	0030 0006	' The menu choices and their actions are:
	0030 0006	'
	0030 0006	' DELETE - Remove a pattern file from the directo
	0030 0006	ry
35	0030 0006	' COPY - Copy a pattern file to a new pattern n
	0030 0006	ame, saving the old pattern
	0030 0006	' RENAME - Change the name of the pattern without
	0030 0006	changing the pattern itself
	0030 0006	' SELECT - Select a pattern for printing
40	0030 0006	' EXIT - Return to the main menu
	0030 0006	'
	0030 0006	'DATA DICTIONARY
	0030 0006	' TYPEZ Which type of valid key was pushed
	0030 0006	' MENUZ Which menu item is being pointer to (0-4)
45	0030 0006	' DIFFZ Distance to move MENUZ at left or right arro
	0030 0006	'
	0030 0006	' FLAGZ Error type 0-4
	0030 0006	' POINTERZ Position of PATNAMEZ in directory list
	0030 0006	' PATNUMZ Number of pattern names in directory
	0030 0006	list
50	0030 0006	' ELNUMZ Number of elements in a pattern file
	0030 0006	' TEMPZ Storage for integers during pattern copy
	0030 0006	' IZ Counter used during pattern copy
	0030 0006	' JZ Counter used during pattern copy
	0030 0006	' AS Misc. input string
55	0030 0006	' FUNCTZ Printed at bottom of screen during prompt fo
	0030 0006	r pattern name
	0030 0006	' PATNAMEZ Pattern name currently being worked on
	0030 0006	' SELNAMEZ Pattern name currently selected for printing

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Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
0030	0036	FILES	Filename of pattern data file
0030	0036	SFILES	Filename for source pattern data file used d
		uring COPY	
0030	0036	DFILES	Filename for destination pattern data file u
		ed during COPY	
0030	0036	NEWNAME\$	New pattern name for COPY and RENAME
0030	0036	TEMP\$	Pattern names are held here as the directory
		is being re-written	
0030	0036	NEWFILES	Destination filename used while copying patt
		ern data files	
0030	0036	MESSAGES	A message printed at the bottom of the scree
		a	
0030	0036	MENUS(4,1)	Array of strings containing the short and lo
		ng send names	
0030	0036	ERRMSG\$	Message printed when any error occurs
0030	0036	ERR\$	Appended to ERRMSG\$ to indicate nature of er
		ror	
0030	0036	TEMP	Storage of real variables while copying patt
		ern data files	
0030	0036	REM \$PAGE	

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Pattern Filing

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Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
0030	0006	SUB PATTERN.FILE STATIC	
0047	0006	GOSUB INITIALIZE	
0047	0006	TYPEZ = 0	
004D	0006		
0054	0008	WHILE TYPEZ <> 3	
0054	0008	AS = ""	
005F	0008	WHILE AS = ""	
0069	000C	AS = INKEY\$	
0078	000C	WEND	
0082	000C	IF AS = CHR\$(0) + CHR\$(75) THEN TYPEZ = 1:	
0085	000C	'left arrow	
00AA	000C	IF AS = CHR\$(0) + CHR\$(77) THEN TYPEZ = 2:	
		'right arrow	
00CF	000C	IF AS = CHR\$(13) THEN TYPEZ = 3:	
		'(cr) to execute selection	
00E9	000C	ON TYPEZ GOSUB T1, T2, T3	
00E9	000C	WEND	
00FB	000C		
00FC	000C	EXIT SUB	
00FC	000C		
0100	000C	REM \$PAGE	
0100	000C		

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

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0100 000C ***** SUB-ROUTINES FOR THIS MODULE *****
0100 000C
0100 000C T1:          'left arrow
25 0105 000C          TYPE1 = 0
010C 000C          IF MENU1 = 0 THEN RETURN
0118 000E          DIFF1 = -1
0122 0010          GOSUB NEW.MENU
0128 0010          RETURN
30 012C 0010
012C 0010 T2:          'right arrow
0131 0010          TYPE1 = 0
0138 0010          IF MENU1 = 4 THEN RETURN
0147 0010          DIFF1 = 1
35 014E 0010          GOSUB NEW.MENU
0154 0010          RETURN
0158 0010
0158 0010 T3:          '<cr> (execute selected menu item)
015D 0010          LOCATE 25,1:PRINT SPACES(79);
40 017A 0010          ON MENU1 + 1 GOSUB T3A, T3B, T3C, T3D, T3E
018F 0010          GOSUB MENU.ON
0195 0010          RETURN
0199 0010
0199 0010          REM SPACE
45

```

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IBM Personal Computer BASIC Compiler V2.00

```

5      0197 0010 TJDA:      delete pattern
      019E 0010      TYPE$ = 0
      01A5 0010      FUNCT$ = "Delete"
      01AF 0014      GOSUB GET.SOURCE
10     01B5 0014      IF LEN(PATNAME$) = 0 THEN RETURN
      01C7 001B      IF PATNAME$ = SELNAME$ THEN FLAG1 = 4:GOSUB SHOW.ERROR:
      RETURN
      01E7 001E      E2SUB SEARCH
      01ED 001E      IF POINTERZ = 0 THEN FLAG1 = 1:GOSUB SHOW.ERROR:RETURN
15     0209 0020      MESSAGE$ = "Deleting " + PATNAME$ + "      Please Wait..
      0209 0020
      0220 0024      GOSUB MESSAGE.ON
      0226 0024
      0226 0024      'rewrite directory deleting PATNAME$ as indicat
20     ed by POINTERZ
      0226 0024      KILL "PATDIR.OLD"
      022D 0024      NAME "PATDIR.RJP" AS "PATDIR.OLD"
      0237 0024      OPEN "PATDIR.OLD" FOR INPUT AS #1
      0248 0024      OPEN "PATDIR.RJP" FOR OUTPUT AS #2
25     025A 0024      INPUT #1, PATNUMZ
      025A 0024      PATNUMZ = PATNUMZ - 1
      026C 0026      WRITE #2,PATNUMZ
      0275 0026
      0286 0026
30     0286 0026      IF PATNUMZ = 0 THEN GOTO DIR.DONE
      0295 0026      FOR IZ = 1 TO PATNUMZ + 1
      02A4 002B          INPUT #1,PATNAME$
      02B6 002B          IF IZ > POINTERZ THEN PRINT #2,PATNAME$
35     02D3 002A      NEXT IZ
      02E5 002A      DIR.DONE:
      02EA 002A          CLOSE #1:CLOSE #2
      02FB 002A
      02FB 002A      'remove data file
40     02FB 002A      FILE$ = RIGHTS(STR$(POINTERZ),LEN(STR$(POINTERZ))-1) +
      "PAT.RJP"
      031C 002E      KILL FILE$
      0323 002E
      0323 002E      'rename remaining data files to maintain linked
45     list with directory
      0373 002E      WHILE (PATNUMZ + 1) > POINTERZ
      0383 002E          SFILES = RIGHTS(STR$(POINTERZ+1),LEN(STR$(POINT
      ERZ+1))-1) + "PAT.RJP"
      0357 0032          DFILES = RIGHTS(STR$(POINTERZ),LEN(STR$(POINTER
50     Z))-1) + "PAT.RJP"
      037D 0036          NAME SFILES AS DFILES
      0387 0036          POINTERZ = POINTERZ + 1
      039C 0036      WEND
55     0393 0036      GOSUB MESSAGE.OFF
      0393 0036      PATNAME$ = SELNAME$
      0399 0036      GOSUB TJDA
      03A3 0036      GOSUB DISP.DIR
      03A9 0036

```

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Offset Data Source Line

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30

03AF 0036 RETURN
03B3 0036
03B3 0036 REM \$PAGE

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IBM Personal Computer BASIC Coeditor V2.00

Offset	Data	Source Line
5	0383 0036	733: Copy pattern
	0388 0036	TYPEZ = 0
	038F 0036	IF PATNUMZ = 80 THEN FLAGZ = 3:GOSUB SHOW.ERROR:RETURN
	03D8 0036	FUNCTS = "Copy"
10	03E5 0036	GOSUB GET.SOURCE
	03E8 0036	IF LEN(PATNAME\$) = 0 THEN RETURN
	03F5 0036	GOSUB SEARCH
	0403 0036	IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
	041F 0036	
15	041F 0036	GOSUB GET.NEW.NAME
	0425 0036	IF LEN(NEWNAME\$) = 0 THEN RETURN
	0437 0036	IF LEN(NEWNAME\$) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
		ETURN
	0457 003A	
20	0457 003A	MESSAGES = "Copying " + PATNAME\$ + " to " + NEWNAME\$ + " Please wait.."
		GOSUB MESSAGE.ON
	047C 003A	
	0482 003A	
	0482 003A	'add NEWNAME\$ at end of directory
25	0482 003A	KILL "PATDIR.OLD"
	0489 003A	MAKE "PATDIR.RJP" AS "PATDIR.OLD"
	0493 003A	OPEN "PATDIR.OLD" FOR INPUT AS #1
	04A4 003A	OPEN "PATDIR.RJP" FOR OUTPUT AS #2
	04B6 003A	
30	04B6 003A	INPUT #1, PATNUMZ
	04C8 003A	PATNUMZ = PATNUMZ + 1
	04D1 003A	WRITE #2, PATNUMZ
	04E2 003A	
	04E2 003A	FOR IZ = 1 TO PATNUMZ - 1
35	04F1 003C	INPUT #1, TEMPZ
	0503 0040	PRINT #2, TEMPZ
	0513 0040	NEXT IZ
	0525 0040	PRINT #2, NEWNAME\$
	0535 0040	
40	0535 0040	CLOSE #1:CLOSE #2
	0543 0040	
	0543 0040	'create copy of pattern data file
	0543 0040	FILES = RIGHT\$(STR\$(POINTERZ), LEN(STR\$(POINTERZ)) - 1) + "PAT.RJP"
45	0567 0040	NEWFILES = RIGHT\$(STR\$(PATNUMZ), LEN(STR\$(PATNUMZ)) - 1) + "PAT.RJP"
	058B 0044	
	058B 0044	OPEN FILES FOR INPUT AS #1
	059C 0044	OPEN NEWFILES FOR OUTPUT AS #2
50	05AE 0044	
	05AE 0044	INPUT #1, ELNUMZ
	05C9 0046	WRITE #2, ELNUMZ
	05D1 0046	
	05D1 0046	FOR IZ = 1 TO 4
55	05D8 0046	INPUT #1, TEMP
	05EA 004A	WRITE #2, TEMP
	05FA 004A	NEXT IZ
	060A 004A	
	060A 004A	FOR IZ = 1 TO ELNUMZ

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	Offset	Data	Source Line
5	0617	004C	FOR J% = 1 TO 6
	061E	004C	INPUT #1,TEMP%
	0630	004E	WRITE #2,TEMP%
	0641	004E	NEXT J%
10	0651	0050	NEXT I%
	0663	0050	CLOSE #1:CLOSE #2
	0671	0050	GOSUB MESSAGE.OFF
15	0677	0050	GOSUB DISP.DIR
	067D	0050	RETURN
	0681	0050	T3C: 'rename pattern
	0686	0050	TYPE% = 0
20	068D	0050	FUNCT% = "Rename" -
	0697	0050	GOSUB GET.SOURCE
	069D	0050	IF LEN(PATNAME%) = 0 THEN RETURN
	06AF	0050	GOSUB SEARCH
	06B5	0050	IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
25	06D1	0050	GOSUB GET.NEW.NAME
	06D1	0050	IF LEN(NEWNAME%) = 0 THEN RETURN
	06D7	0050	IF LEN(NEWNAME%) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
	06E9	0050	ETURN
30	0709	0050	IF NEWNAME% = PATNAME% THEN RETURN
	071C	0050	MESSAGES = "Renaming " + PATNAME% + " to " + NEWNAME% +
	071C	0050	" Please wait..."
	0741	0050	GOSUB MESSAGE.CM
35	0747	0050	'change pattern name in directory replacing PAT
	0747	0050	NAME% with NEWNAME%
	0747	0050	KILL "PATDIR.OLD"
	074E	0050	NAME "PATDIR.RJP" AS "PATDIR.OLD"
40	075B	0050	OPEN "PATDIR.OLD" FOR INPUT AS #1
	0769	0050	OPEN "PATDIR.RJP" FOR OUTPUT AS #2
	077B	0050	INPUT #1, PATNUM%
	077B	0050	WRITE #2,PATNUM%
	078D	0050	
45	079E	0050	FOR I% = 1 TO PATNUM%
	079E	0050	INPUT #1,TEMP%
	07AB	0052	IF I% < POINTER% THEN PRINT #2,TEMP%
	07BD	0052	IF I% = POINTER% THEN PRINT #2,NEWNAME%
	07DA	0052	NEXT I%
50	07F7	0052	
	0809	0052	CLOSE #1:CLOSE #2
	0809	0052	
	0817	0052	GOSUB MESSAGE.OFF
55	081D	0052	'select new pattern name if necessary
	081D	0052	IF PATNAME% = SELNAME% THEN PATNAME% = NEWNAME%:GOSUB T
	081D	0052	
	083C	0052	GOSUB DISP.DIR

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

```

0842 0052      RETURN
0846 0052
10 0846 0052  REM SPACE

```

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Pattern Filing

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

```

20 0846 0052  T3D:      'select pattern for printing
0848 0052      TYPE1 = 0
0852 0052      FUNCT$ = 'Select'
085C 0052      GOSUB GET.SOURCE
25 0862 0052      IF LEN(PATNAME$) = 0 THEN RETURN
0874 0052      IF PATNAME$ = SELNAME$ THEN RETURN
0887 0052      GOSUB T3DA
088D 0052      GOSUB DISP.DIR
0893 0052      RETURN
30 0897 0052
0897 0052  T3DA:
089C 0052      GOSUB SEARCH
08A2 0052      IF POINTER1 = 0 THEN FLAG1 = 1:GOSUB SHOW.ERROR:RETURN
08BE 0052
35 08BE 0052      MESSAGE$ = 'Selecting ' + PATNAME$ + '      Please Wait.
      .."
08D5 0052      GOSUB MESSAGE.ON
08DB 0052
08DB 0052      'change entrys in pattern default file PATDEF.R
40 08DB 0052  JP
08DB 0052      OPEN "PATDEF.RJP" FOR OUTPUT AS #1
08ED 0052      FILE$ = RIGHT$(STR$(POINTER1),LEN(STR$(POINTER1))-1) +
      "PAT.RJP"
45 08F1 0052
08F1 0052      PRINT #1,FILE$
0921 0052      PRINT #1,PATNAME$
0931 0052
0931 0052      CLOSE #1
0938 0052      GOSUB MESSAGE.OFF
50 093E 0052      RETURN
0942 0052
0942 0052  T3E:      'exit pattern filing
0947 0052      RETURN
094B 0052
65 094B 0052  REM SPACE

```

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Offset	Data	Source Line
5	094B 0052	SEARCH:
	0950 0052	POINTERS = 0
	0957 0052	OPEN "PATDIR.RJP" FOR INPUT AS #1
	0968 0052	INPUT #1,PATNUM1: ' get number of patterns in direc
10		tory
	097A 0052	IF PATNUM1 = 0 THEN CLOSE #1:RETURN
	0990 0052	TEMP\$ = ""
	099A 0052	WHILE (POINTERS < PATNUM1) AND (PATNAME\$ (> TEMP\$)
	09C2 0052	LINE INPUT #1,TEMP\$
15	09CF 0052	POINTERS = POINTERS + 1
	09D8 0052	WEND
	09D8 0052	IF PATNAME\$ (> TEMP\$ THEN POINTERS = 0
	09F1 0052	CLOSE #1
	09FB 0052	RETURN
20	09FC 0052	
	09FC 0052	GET.SOURCE:
	0A01 0052	LOCATE 25,1:COLOR 15,0:PRINT "Enter Pattern Name to 'FU
		NCTS" ";
	0A33 0052	LINE INPUT: "",PATNAME\$
25	0A41 0052	LOCATE 25,1:PRINT SPACES(79);
	0A5E 0052	RETURN
	0A62 0052	
	0A62 0052	GET.NEW.NAME:
	0A67 0052	LOCATE 25,1:COLOR 15,0:PRINT "Enter New Pattern Name ";
30	0A8D 0052	LINE INPUT: "",NEWNAME\$
	0A98 0052	LOCATE 25,1:PRINT SPACES(79);
	0A88 0052	RETURN
	0ABC 0052	
	0ABC 0052	DISP.DIR: 'display directory in 4 columns, 20 rows
35	0AC1 0052	'read default pattern name into SELNAME\$
	0AC1 0052	OPEN "PATDEF.RJP" FOR INPUT AS #1
	0AD2 0052	INPUT #1,SELNAME\$: 'discard data file name
	0AE4 0052	INPUT #1,SELNAME\$
	0AF6 0052	CLOSE #1
40	0AFD 0052	
	0AFD 0052	OPEN "PATDIR.RJP" FOR INPUT AS #1
	0B0E 0052	INPUT #1,PATNUM1: ' read number of patterns
	0B20 0052	
	0B20 0052	MESSAGE\$ = "Reading Pattern Directory Please Wait"
45	0B2A 0052	GOSUB MESSAGE.ON
	0B30 0052	FLAG1 = 0
	0B37 0052	TEMP1 = PATNUM1 - 1: IF PATNUM1 < 80 THEN TEMP1 = PATNUM
		1
	0B52 0052	FOR I1 = 0 TO TEMP1
50	0B5E 0054	LOCATE (I1 MOD 20)+1,(INT(I1/20)*20)+1
	0B91 0054	PRINT SPACES(18);
	0BA1 0054	NEXT I1
	0BB3 0054	
	0BB3 0054	FOR I1 = 0 TO PATNUM1 - 1
	0BC1 0056	INPUT #1,PATNAME\$
55	0B03 0056	LOCATE (I1 MOD 20)+1,(INT(I1/20)*20)+3
	0C06 0056	PRINT PATNAME\$;
	0C13 0056	IF PATNAME\$ = SELNAME\$ THEN LOCATE (I1 MOD 20)+
		1,(INT(I1/20)*20)+1:PRINT " ";

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```

5      0C62 0056      NEXT IZ
      0C77 0056      CLOSE #1
      0C7E 0056      GOSUB MESSAGE.OFF
      0C84 0056      RETURN
10     0C86 0056
      0C88 0056      INITIALIZE:
      0C8D 0056      DIM MENU$(4,1)
      0C8E 007E      MENU$(0,0) = "Delete"
      0CA6 007E      MENU$(0,1) = "Remove a pattern file from the directory"
15     0CC1 007E      MENU$(1,0) = "Copy"
      0CDC 007E      MENU$(1,1) = "Copy a pattern file to a new pattern name

      0CF5 007E      MENU$(2,0) = "Rename"
      0D12 007E      MENU$(2,1) = "Rename a pattern file in the directory"
20     0D30 007E      MENU$(3,0) = "Select"
      0D4B 007E      MENU$(3,1) = "Select a pattern file to be printed"
      0D67 007E      MENU$(4,0) = "Exit"
      0D82 007E      MENU$(4,1) = "Return to the main menu"
      0D9E 007E
25     0D9E 007E      COLOR 9,0:CLS
      0DB1 007E      LOCATE 21,1
      0DBE 007E      FOR IZ = 1 TO 80
      0DC5 007E          PRINT "0";
      0DD2 007E      NEXT IZ
30     0DE2 007E
      0DE2 007E      FOR MENUZ = 0 TO 4
      0DE8 007E          GOSUB MENU.OFF
      0DEE 007E      NEXT MENUZ
      0DFE 007E
35     0DFE 007E      GOSUB DISP.DIR
      0E04 007E      IF FLAGZ > 0 THEN GOSUB SHOW.ERROR
      0E15 007E      MENUZ = 4
      0E1C 007E      GOSUB MENU.ON
      0E22 007E
40     0E22 007E      RETURN
      0E26 007E
      0E26 007E      NEW.MENU:
      0E2B 007E          GOSUB MENU.OFF
      0E31 007E          MENUZ = MENUZ + DIFFZ
      0E3D 007E          GOSUB MENU.ON
45     0E43 007E      RETURN
      0E47 007E
      0E47 007E      MENU.ON:
      0E4C 007E          LOCATE 22,(MENUZ*10)+18
      0E43 007E          COLOR 0,7
50     0E4F 007E          PRINT MENU$(MENUZ,0);
      0EBD 007E          LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
      0EC1 007E          COLOR 7,0
      0ECD 007E          PRINT MENU$(MENUZ,1);
      0EEC 007E      RETURN
65     0EF0 007E
      0EF0 007E      MENU.OFF:
      0EF5 007E          LOCATE 22,(MENUZ*10)+18
      0F0C 007E          COLOR 14,0

```

Reagent Jet Printer
Pattern Filing

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IBM Personal Computer BASIC Compiler V2.00

```

5      Offset Data      Source Line
      0F18 007E      PRINT MENU$(MENUZ,0);
      0F36 007E      LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
      0F6A 007E      PRINT SPACES(LEN(MENU$(MENUZ,1)));
      0F8F 007E      RETURN
10     0F93 007E      SHOW.ERROR:
      0F93 007E      ON FLAG1 GOSUB ER1, ER2, ER3, ER4
      0F98 007E      ERRMSG$ = ERR$ + " Strike any key.."
      0FA9 007E      LOCATE 24,40-LEN(ERRMSG$)/2
      0FB9 0086      COLOR 13,0
15     0FDB 0086      PRINT ERRMSG$;
      0FE7 0086      AS = ""
      0FF4 0086      WHILE AS = ""
      0FFE 0086          AS = INKEY$
20     100D 0086      WEND
      1017 0086      GOSUB MESSAGE.OFF
      101A 0086      RETURN
      1020 0086
      1024 0086      ER1:
25     1024 0086      ERR$ = PATNAME$ + " Not Found in the Directory"
      1029 0086      RETURN
      103D 0086      ER2:
      103D 0086      ERR$ = "Pattern Name is too Long (15 characters max.)"
30     1042 0086      RETURN
      104C 0086
      1050 0086      ER3:
      1050 0086      ERR$ = "Directory is Full (80 patterns max.)"
      1055 0086      RETURN
35     105F 0086
      1063 0086      ER4:
      1063 0086      ERR$ = "Cannot Modify SELECTd pattern Name"
      1068 0086      RETURN
      1072 0086
      1076 0086      MESSAGE.ON:
40     1076 0086      LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
      107B 0086      GE$;
      1086 0086      RETURN
      108A 0086
45     108A 0086      MESSAGE.OFF:
      108A 0086      LOCATE 24,1:COLOR 15,0:PRINT SPACES(79);
      108F 0086      RETURN
      10EB 0086
      10EC 0086
50     10EC 0086      END SUB
      10F3 0086
      1688 0086

```

50426 Bytes Available
45670 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

Reagent Jet Printer
Main Line Code

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
0030	0006	REM \$TITLE: 'Reagent Jet Printer' \$SUBTITLE: 'Main Line Code'
0030	0006	
0030	0006	'MODULE - "MAIN"
0030	0006	
0030	0006	'AUTHOR - M. A. Enevold
0030	0006	
0030	0006	'COPYRIGHT (C) 1986 ABBOTT LABORATORIES
0030	0006	
0030	0006	'REVISION - 1.1 02-19-86 NAE Add notes and revise TYPEZ resetin
0030	0006	g
0030	0006	- 1.0 02-14-86 NAE Creation of initial code
0030	0006	
0030	0006	'SYSTEM - This code can only be compiled by the BASCOM
0030	0006	COMPILER, it will not run under the INTERPRETER!!
0030	0006	
0030	0006	'DESCRIPTION
0030	0006	This is the main controlling module for the Reagent Jet
0030	0006	Printer.
0030	0006	It displays a menu in table form that allows 6 function
0030	0006	s to be
0030	0006	selected. PATTERN DEFINITION allows the user to define
0030	0006	patterns
0030	0006	to be printed. PATTERN FILING lets the user delete, co
0030	0006	py, rename
0030	0006	and select patterns for printing. REAGENT CALIBRATION
0030	0006	permits setting
0030	0006	of operation parameters for different reagents. REAGEN
0030	0006	T FILING is
0030	0006	the same as pattern filing. PRINTING PRINT prints the
0030	0006	selected
0030	0006	pattern with the selected reagent. SYSTEM EXIT TO DOS
0030	0006	ends the session.
0030	0006	Using up and down arrow keys let the user move through
0030	0006	the menu and
0030	0006	the Enter (cr) key activates the selection.
0030	0006	
0030	0006	'DATA DICTIONARY
0030	0006	MENUZ This value represents the current menu
0030	0006	item (0-5)
0030	0006	MENU\$(5,1) String array for displaying menu items.
0030	0006	6 rows by 2 columns
0030	0006	Each row corresponds to a menu item (0-
0030	0006	5)
0030	0006	First column is short menu name in high
0030	0006	lighted area
0030	0006	Second column is long description displ
0030	0006	ayed at menu bottom
0030	0006	MROWZ(5) This array stores to row in which the s
0030	0006	hort menu name will be displayed
0030	0006	DIFFZ This value is used to change MENUZ in r
0030	0006	esponse to arrow keys
0030	0006	TYPEZ This value is set based on which valid
0030	0006	key is pressed
0030	0006	0 = No valid key. 1 = Up Arrow. 2 = D

Reagent Jet Printer
Main Line Code

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5 Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

own Arrow. J = <cr>.

0030 0006 ' TEMP1 Used to store MENU1 while screen is ref

reshed

10 0030 0006 ' A\$ Used to store single input keystrokes

0030 0006 ' C\$ Used to store special graphics characte

rs used in drawing the menu table

0030 0006 ' I% Counter used to reifresh display

15 0030 0006 ' R% Row in which special graphics character

is displayed

0030 0006 ' C% Column in which special graphics charac

ter is displayed

0030 0006 REM \$PAGE

Reagent Jet Printer
Main Line Code

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20 Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

25 0030 0006 'Main-line code for RJP Reagent Jet Printer

0030 0006 MAIN.LINE.CODE:

30 0030 0006 GOSUB INITIALIZE

0030 0006 WHILE TYPE1 <> 3

0030 0006 TYPE1 = 0

35 0030 0006 A\$ = ""

0030 0006 WHILE A\$ = ""

0030 0006 A\$ = INKEY\$

0030 0006 WEND

40 0030 0006 IF A\$ = CHR\$(0) + CHR\$(72) THEN TYPE1 = 1:

0030 0006 up arrow

0030 0006 IF A\$ = CHR\$(0) + CHR\$(80) THEN TYPE1 = 2:

down arrow

45 0030 0006 IF A\$ = CHR\$(13) THEN TYPE1 = 3:

<cr> execute command

0030 0006 ON TYPE1 GOSUB T1, T2, T3

0030 0006 WEND

50 0030 0006 CLS

0030 0006 COLOR 7,0,0

0030 0006 SYSTEM

55 0030 0006 REM \$PAGE

Reagent Jet Printer

Main Line Code

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IBM Personal Computer BASIC Compiler V2.00

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Offset Data Source Line
0116 000C '***** SUB-ROUTINES FOR MAIN PROGRAM
0116 000C T1: 'up arrow
0118 000C IF MENUZ = 0 THEN RETURN
012A 000E DIFFZ = -1
0131 0010 GOSUB NEW.MENU
0137 0010 RETURN
0138 0010
013B 0010 T2: 'down arrow
0140 0010 IF MENUZ = 5 THEN RETURN
014F 0010 DIFFZ = 1
0156 0010 GOSUB NEW.MENU
015C 0010 RETURN
0160 0010
0160 0010 T3:
0165 0010 ON MENUZ + 1 GOSUB T31, T32, T33, T34, T35, T36
017C 0010 IF MENUZ < 5 THEN TYPEZ = 0: reset TYPEZ so program
won't end
015E 0010 SCREEN 0,0,3,3
01A5 0010 RETURN
01A9 0010
01A9 0010 T31: 'pattern definition
01AE 0010 CALL PATENTRY: 'in module PATENT
01BA 0010 GOSUB REFRESH
01C0 0010 RETURN
01C4 0010
01C4 0010 T32: 'pattern filing
01C9 0010 SCREEN 0,0,0,0:CLS
01E5 0010 CALL PATERN.FILE: 'in module PATFILE
01F1 0010 RETURN
01F5 0010
01F5 0010 T33: 'reagent calibration
01FA 0010 CALL REAGENT.CALIBRATE: 'in module REACAL
0206 0010 RETURN
020A 0010
020A 0010 T34: 'reagent filing menu
020F 0010 SCREEN 0,0,0,0:CLS
022B 0010 CALL REAGENT.FILE: 'in module REAFILE
0237 0010 RETURN
023B 0010
023B 0010 T35: 'print pattern
0240 0010 CALL PATPRINT: 'in module PATPRINT
024C 0010 RETURN
0250 0010
0250 0010 T36: 'exit system, don't reset TYPEZ
0255 0010 RETURN
0259 0010
0259 0010 REM $PAGE

```

Reagent Jet Printer
Main Line Code

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IBM Personal Computer BASIC Compiler V2.00

```

5      0259 0010 NEW.MENU:
      025E 0010      GOSUB MENU.OFF
      0264 0010      MENUZ = MENUZ + DIFFZ
      0270 0010      GOSUB MENU.ON
10     0276 0010      RETURN
      027A 0010
      027A 0010 INITIALIZE:
      027F 0010      CALL PCI.INIT
      028B 0010
      028B 0010      define and initialize arrays
15     028B 0010      DIM ROWZ(5)
      028C 0010      ROWZ(0) = 4
      029E 0010      ROWZ(1) = 6
      02B1 0010      ROWZ(2) = 10
      02C4 0010      ROWZ(3) = 12
20     02D7 0010      ROWZ(4) = 16
      02EA 0010      ROWZ(5) = 20
      02FD 0010
      02FD 0010      DIM MENU$(5,1)
      02FE 004C      RESTORE MENU.STRING.DATA
25     0305 004C      FOR IZ = 0 TO 5
      030B 004C          READ MENU$(IZ,0),MENU$(IZ,1)
      033B 004E      NEXT IZ
      034B 004E
      034B 004E      set initial values into variables
30     034B 004E      TYPEZ = 0
      0352 004E      MENUZ = 0
      0359 004E
      0359 004E REFRESH: redraw screen and highlight current menu selection
35     035E 004E
      035E 004E      SCREEN 0,0,0:CLS:COLOR 7,0,0
      03BB 004E      LOCATE 10,32:PRINT "Loading Menu....."
      03A5 004E      SCREEN 0,0,3,0:CLS
      03C2 004E
      03C2 004E
40     03C2 004E      COLOR 13,0
      03CE 004E      LOCATE 1,31
      03DB 004E      PRINT "REAGENT JET PRINTER";
      03EB 004E      CLCLR 10,0
      03F4 004E      LOCATE 5,26
45     0401 004E      PRINT "PATTERN"
      040E 004E      LOCATE 11,26
      041B 004E      PRINT "REAGENT"
      042B 004E      LOCATE 16,26
      0435 004E      PRINT "PRINTING"
50     0442 004E      LOCATE 20,27
      044F 004E      PRINT "SYSTEM"
      045C 004E
      045C 004E      draw the menu table in special graphics characters
      045C 004E      COLOR 9,0
55     046B 004E      FOR IZ = 18 TO 63
      046F 004E          LOCATE 2,IZ:PRINT "0";
      04BA 004E          LOCATE 8,IZ:PRINT "0";
      04A5 004E          LOCATE 14,IZ:PRINT "0";

```

Reagent Jet Printer
Main Line Code

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```

Offset  Data  Source Line  IBM Personal Computer BASIC Compiler V2.00

5      04C0 004E          LOCATE 18,12:PRINT "D";
      04DB 004E          LOCATE 22,12:PRINT "D";
      04F6 004E          LOCATE 24,12:PRINT "D";
      0511 004E      NEXT IZ
10     0524 004E      FOR IZ = 3 TO 23
      052B 004E          LOCATE 12,17:PRINT "J";
      0546 004E          LOCATE 12,64:PRINT "J";
      0561 004E      NEXT IZ
      0571 004E      RESTORE TABLE
15     057B 004E      FOR IZ = 1 TO 12
      057F 004E          READ RZ,CZ,C$
      0592 0056          LOCATE RZ,CZ:PRINT C$;
      05AE 0056      NEXT IZ
      05BE 0056
20     056E 0056      print the instructions
      056E 0056      COLOR 7,0
      05CA 0056      LOCATE 25,6
      05D7 0056      PRINT "Use or to highlight menu items. Use to
                        activate selection.";
25     05E4 0056
      05E4 0056      COLOR 15,0
      060A 0056      LOCATE 25,15:PRINT "";
      0624 0056      LOCATE 25,47:PRINT "DY";
30     063E 0056
      063E 0056      display the 6 menu choices
      063E 0056      TEMP1 = MENUZ
      0645 0058      FOR MENUZ = 0 TO 5
      064B 0058          GOSUB MENU.OFF
35     0651 0058      NEXT MENUZ
      0661 0058      MENUZ = TEMP1
      0668 0058
      0668 0058      highlight the currently active menu item
      0668 0058      GOSUB MENU.ON
40     066E 0058
      066E 0058      SCREEN 0,0,3,3
      0685 0058      RETURN
      0689 0058
      0689 0058      MENU.ON: highlight the menu MENUZ and display its long description
45     068E 0058          COLOR 0,7
      069A 0058          LOCATE MROWZ(MENUZ),52-LEN(MENUS(MENUZ,0))/2
      06DA 0058          PRINT MENUS(MENUZ,0);
      06F6 0058          COLOR 7,0
50     0704 0058          LOCATE 23,40.5-LEN(MENUS(MENUZ,1))/2
      073B 0058          PRINT MENUS(MENUZ,1);
      0757 0058          RETURN
      075B 0058
      075B 0058      MENU.OFF: un-highlight menu MENUZ and erase long description
55     0760 0058          COLOR 14,0
      076C 0058          LOCATE MROWZ(MENUZ),52-LEN(MENUS(MENUZ,0))/2
      07AC 0058          PRINT MENUS(MENUZ,0);
      07CA 0058          COLOR 7,0
      07D6 0058          LOCATE 23,40.5-LEN(MENUS(MENUZ,1))/2

```

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Reagent Jet Printer
Main Line Code

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IBM Personal Computer BASIC Compiler V2.00

Offset Data Source Line

30

060A 005B PRINT SPACES(LEN(MENU\$(MENUZ,1)));
022F 605B RETURN
0833 005B
0833 005B REM \$PAGE

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Reagent Jet Printer
Main Line Code

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```

5      Offset Data   Source Line      IBM Personal Computer BASIC Compiler V2.00

      0633 0058 ***** DATA FIELDS USED BY THE MAIN PROGRAM *****
      0633 0058
10     0633 0058 MENU.STRING.DATA:      'first entry is menu name, second is lo
      ng description

      0838 0058
      0838 0058          DATA 'DEFINITION', 'Create and Modify Patterns'
      083A 0058          DATA 'FILING',      'Delete, Copy, Rename, and Select Pa
15     tterns'
      083C 0058          DATA 'CALIBRATION', 'Calibrate and Modify Reagent Profil
      es'
      083E 0058          DATA 'FILING',      'Delete, Copy, Rename, and Select Re
20     agents'
      0840 0058          DATA 'PRINT',       'Print Selected Pattern with Selecte
      d Reagent'
      0842 0058          DATA 'EXIT TO DOS', 'Leave Program and Return to DOS'
      0844 0058
      0844 0058 TABLE: 'first entry is row, second is column, third is special
25     graphics character

      0849 0058          DATA 2,17,'Z'
      0849 0058          DATA 2,64,'?'
      084B 0058          DATA 8,17,'C'
      084D 0058          DATA 8,64,'4'
30     084F 0058          DATA 14,17,'C'
      0851 0058          DATA 14,64,'4'
      0853 0058          DATA 18,17,'C'
      0855 0058          DATA 18,64,'4'
      0857 0058          DATA 22,17,'C'
      0859 0058          DATA 22,64,'4'
35     085B 0058          DATA 24,17,'P'
      085D 0058          DATA 24,64,'T'
      085F 0058
      0861 0058          END
40     0861 0058
      0865 0058
      0842 0058

```

50426 Bytes Available
47680 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

50 Claims

1. A dispensing system for use in diagnostic instruments for precise metering of a desired diagnostic fluid, the system comprising:
 - 55 a jetting chamber defining a volume and comprising a first and second aperture, the first aperture adapted to receive diagnostic fluid, the second aperture defining an orifice;
 - a transducer in mechanical communication with the jetting chamber, the transducer operative to alternately expand and de-expand the volume of the jetting chamber in response to a selected electrical pulse and

thereby cause the jetting chamber to omit a substantially uniformly sized droplet of diagnostic fluid through the orifice; and
 means for generating a number of electrical pulses sufficient to cause a desired quantity of the diagnostic fluid to be dispensed.

5 2. The invention of Claim 1 wherein the system further comprises:

at least one additional jetting chamber in fluid communication with an additional diagnostic fluid;
 at least one additional transducer in mechanical communication with the additional jetting chamber;
 at least one additional means for applying an electrical pulse to the additional transducer;
 means for generating respective numbers of electrical pulses sufficient to cause precise quantities of the
 10 diagnostic fluids to be dispensed in a desired volumetric ratio; and
 a receptacle adapted for and positioned to receive the fluids.

3. The invention of Claim 1 wherein the system further comprises:

means for directing at least one of (1) the receptacle and (2) the emitted diagnostic fluid and the emitted
 additional diagnostic fluid such that desired quantities of the fluids are dispensed into the receptacle in a
 15 predefined dispensing order.

4. The invention of Claim 1 wherein one of the diagnostic fluids comprises serum and wherein the
 jetting chambers cooperate such that the other diagnostic fluid is emitted in a manner to contact and mix
 with the serum.

5. The invention of Claim 1 wherein the jetting chamber comprises a cylindrical tube and wherein the
 20 transducer is mounted concentrically about the cylindrical tube.

6. The invention of Claim 1 wherein the jetting chamber is conically shaped.

7. The invention of Claim 1 wherein the jetting chamber comprises at least one chamber wall which is
 integrally formed with the transducer.

8. The invention of Claim 1 wherein the transducer is one of (1) a piezo-electric transducer; (2) a
 25 magneto-strictive transducer; (3) an electro-strictive transducer; and (4) an electro-mechanical transducer.

9. The invention of Claim 1 wherein the jetting chamber is conically shaped; and wherein the transducer
 is disc shaped and forms the base of the conically shaped jetting chamber.

10. The invention of Claim 1 wherein the orifice comprises an end face and the end face is coated with
 a hydrophobic polymer.

30 11. The invention of Claim 1 wherein the transducer is cylindrically shaped and comprises a first
 electrode located on the inner wall of the cylinder and wraps around one end of the cylinder and wherein a
 second electrode is located substantially on the outer wall of the cylinder and is electrically isolated from
 the first electrode.

12. The invention of Claim 1 wherein the means for generating produces an electrical pulse of selected
 35 rise and fall time constants and of selected duration, voltage and polarity.

13. The invention of Claim 1 wherein the means for generating the electrical pulse comprises means for
 scaling the voltage of the pulse in response to a selectable digital value.

14. The invention of Claim 1 wherein the apparatus further comprises means for directing the emitted
 diagnostic fluid along a desired path.

40 15. A method of dispensing precise quantities of diagnostic fluids comprising the steps of:

(a) generating an electrical pulse of predefined characteristics;

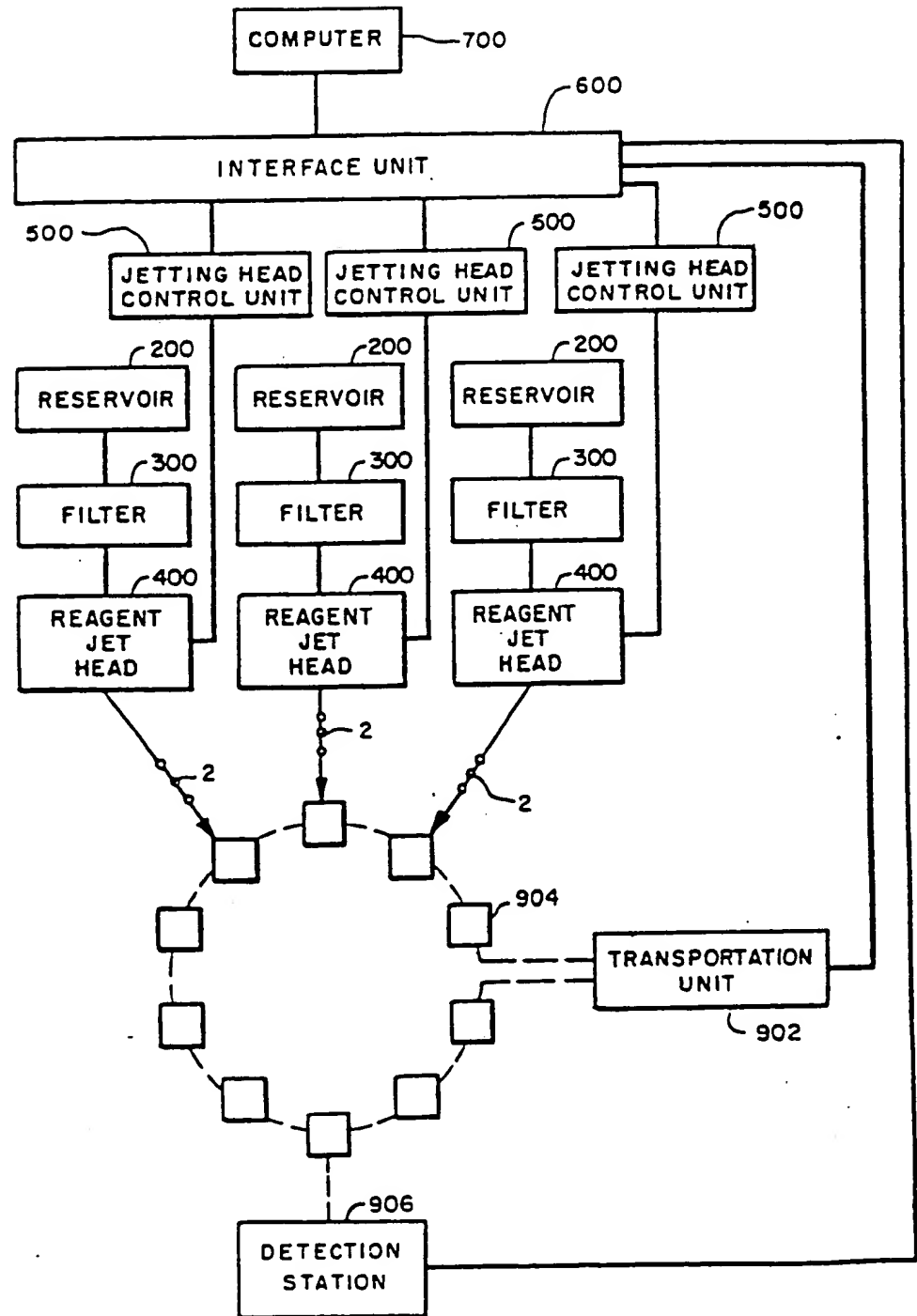
(b) reducing the volume of a chamber containing the diagnostic fluid by electro-mechanical means in
 response to the electrical pulse such that a droplet of fluid of known volume is propelled through an orifice
 in the chamber; and

45 (c) repeating steps (a) and (b) until a desired quantity of the diagnostic fluid has been dispensed

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FIG. 1



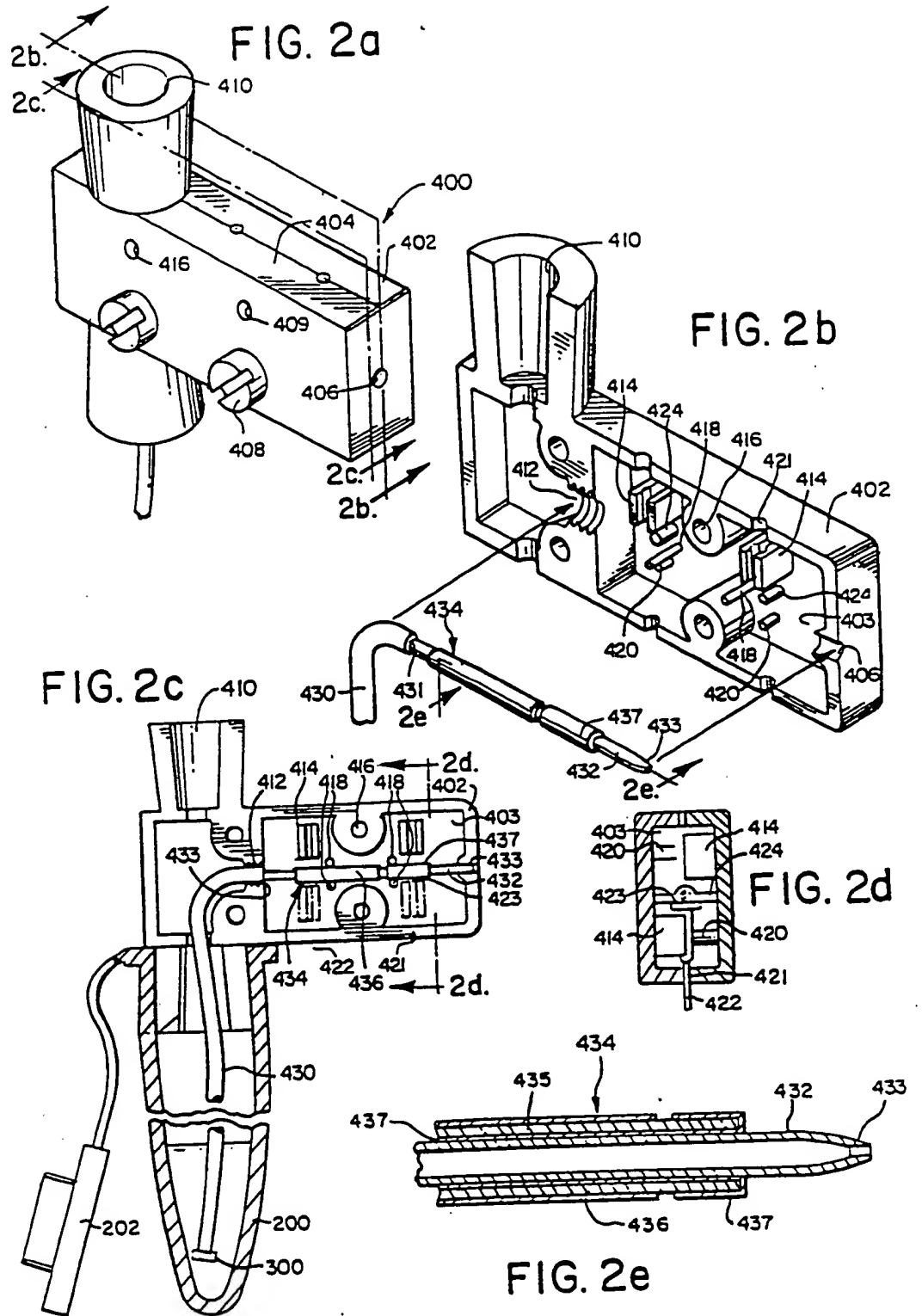


FIG. 3

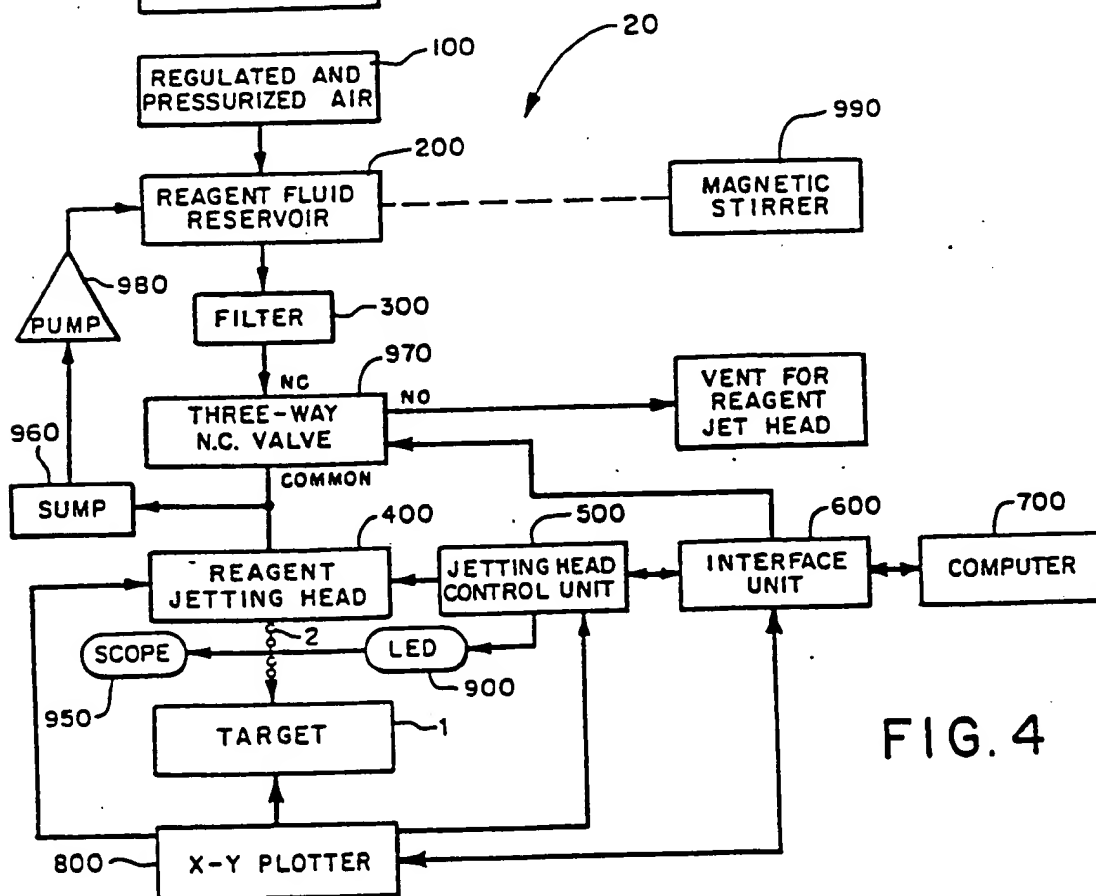
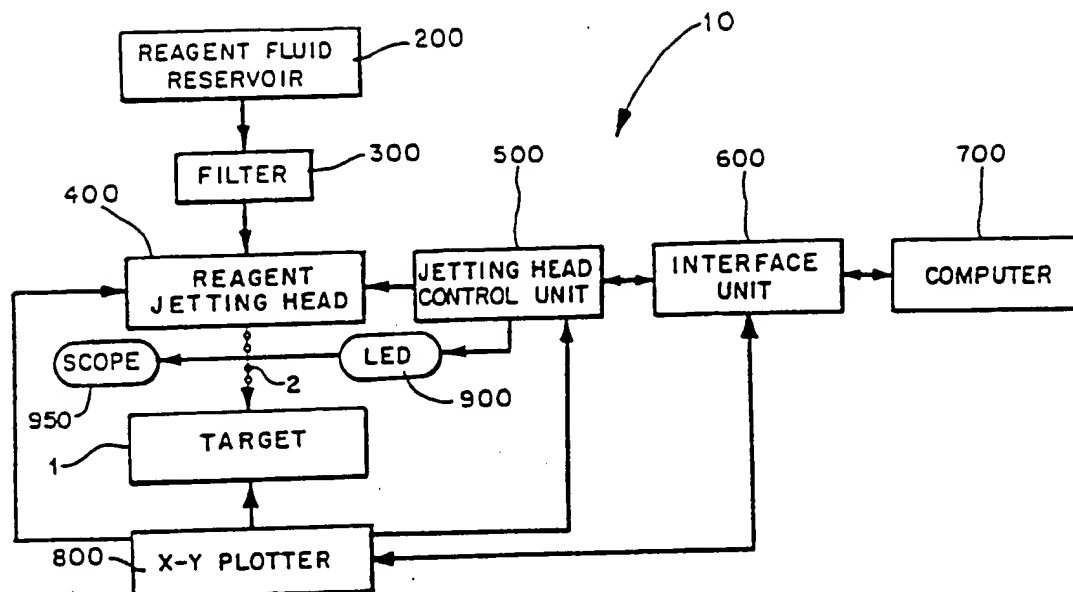


FIG. 4

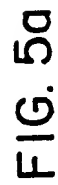




FIG. 5c

FIG. 5d

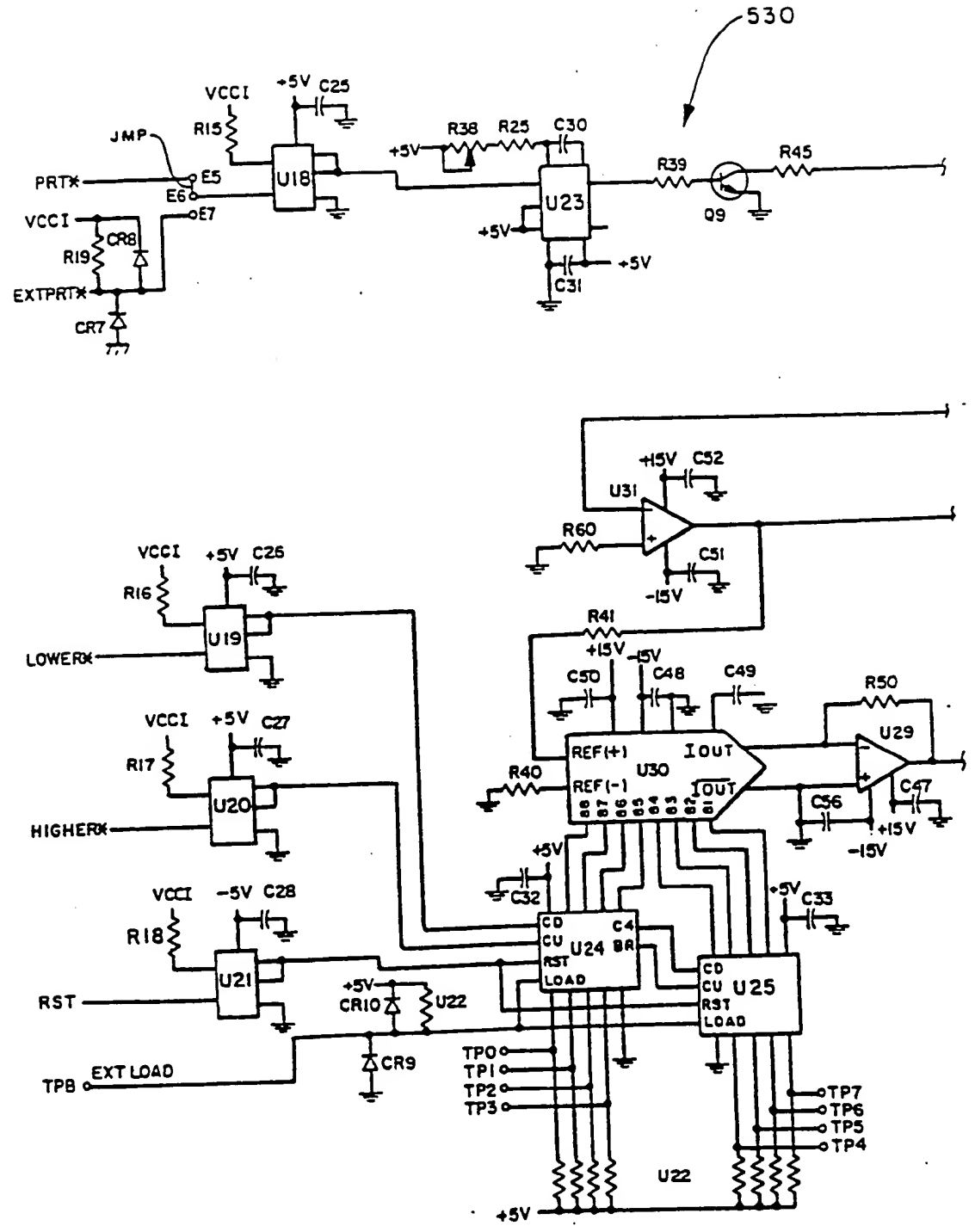


FIG. 5e

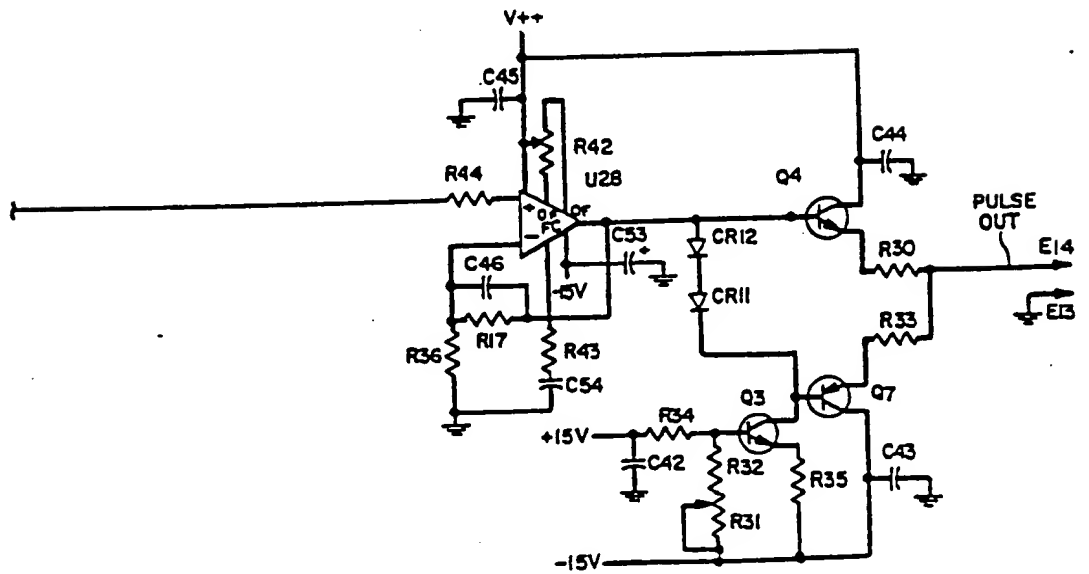
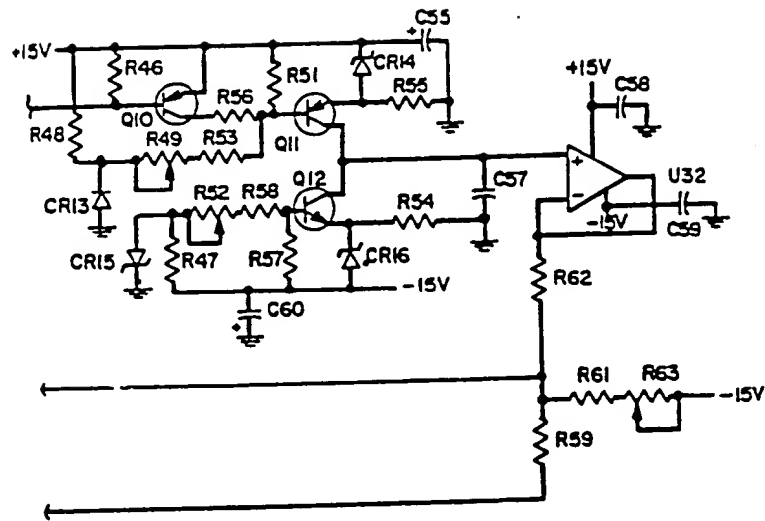


FIG. 6a

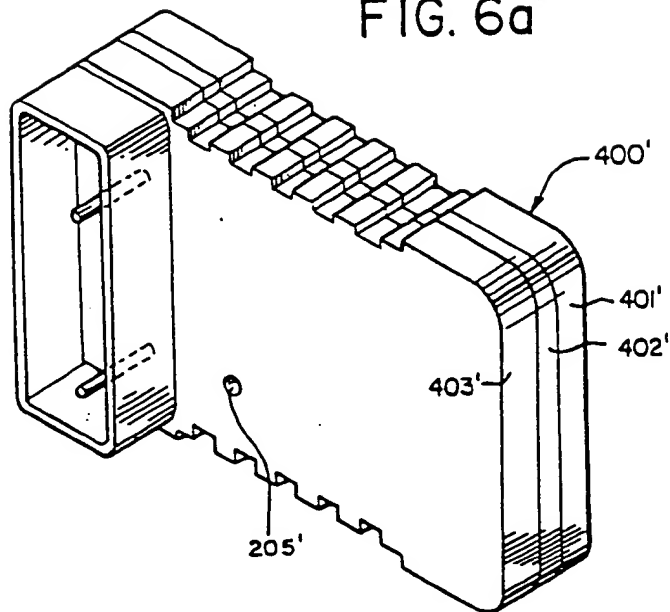


FIG. 7

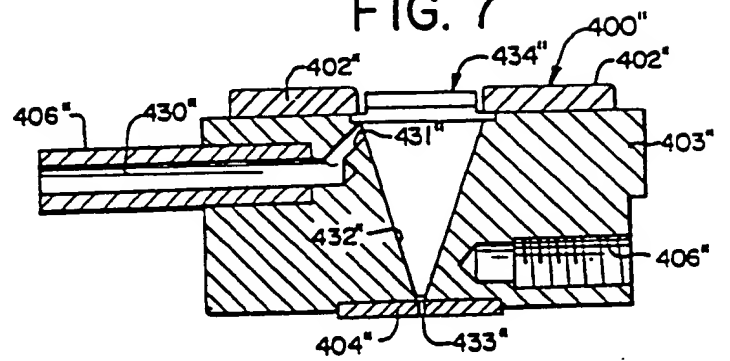
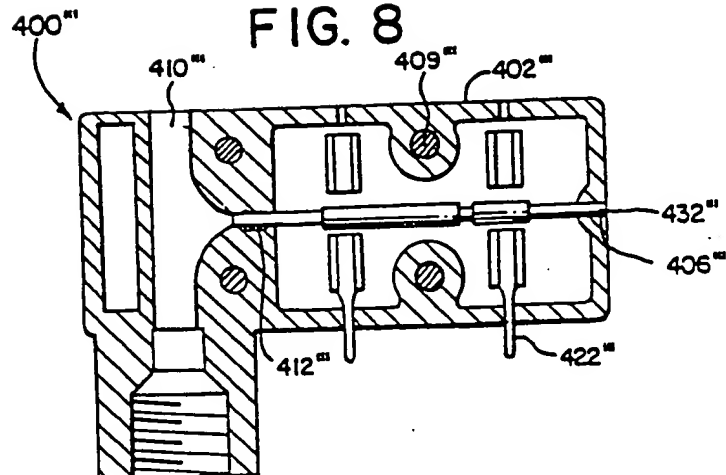
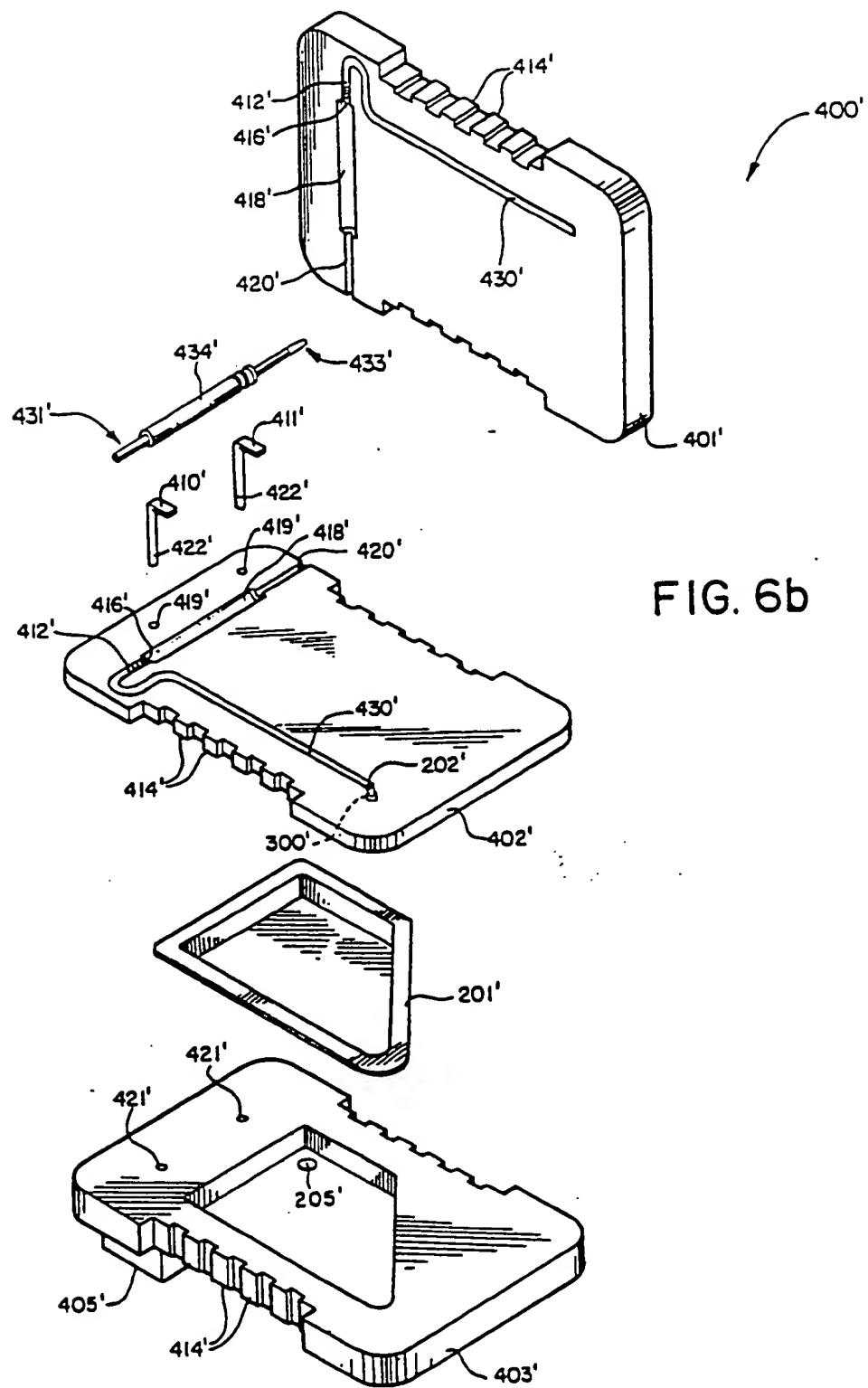


FIG. 8





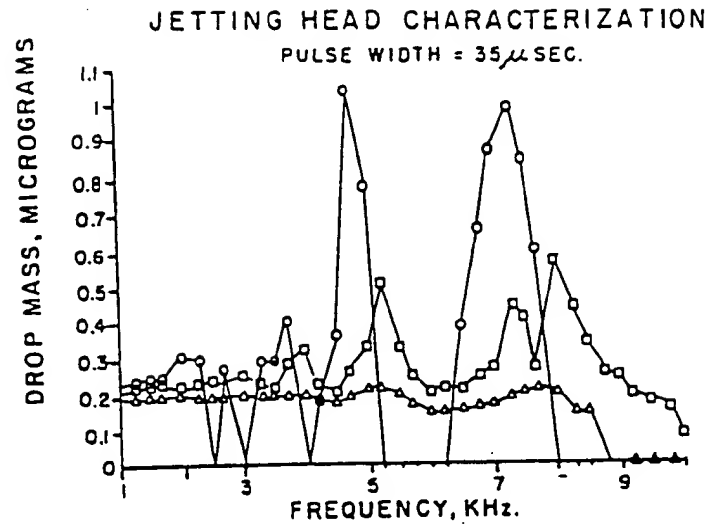


FIG. 9

□ VIS = 5 CP
○ VIS = 1 CP
△ VIS = 24 CP

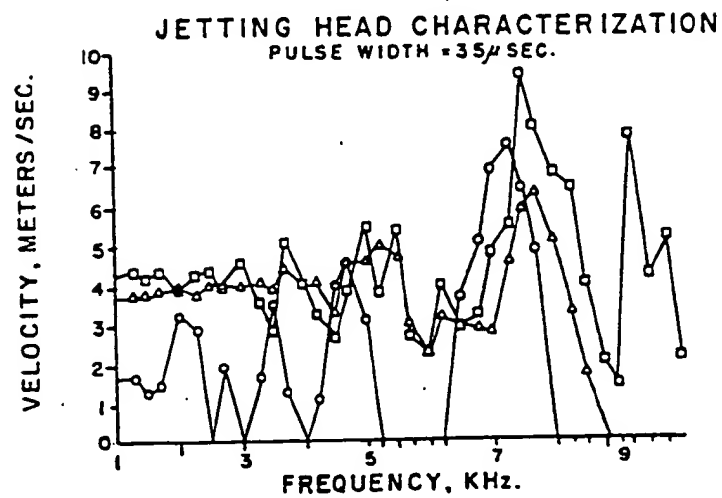


FIG. 10

□ VIS = 5 CP
○ VIS = 1 CP
△ VIS = 24 CP

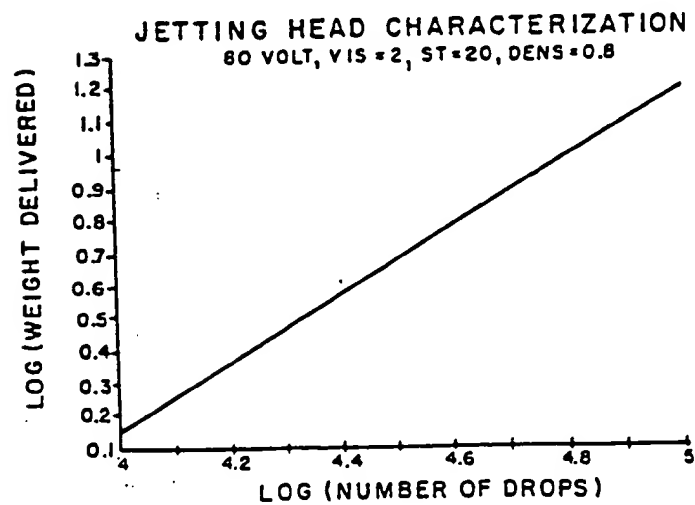


FIG. 11